Journal of the Society of Arts.

FRIDAY, MAY 15, 1863.

TWELFTH ANNUAL CONFERENCE.—NOTICE TO INSTITUTIONS AND LOCAL BOARDS.

The Twelfth Annual Conference of the representatives of Institutions in Union, and of the Local Educational Boards, with the Council, will be held on Friday, the 12th June, at Twelve o'clock noon. Sir Thomas Phillips, Chairman of the Council, will preside.

Secretaries of Institutions in Union are requested to forward, *as soon as possible*, to the Secretary of the Society of Arts, the names of the representatives appointed to attend the Conference.

The chairmen of, or representatives from, the Local Educational Boards are invited to attend. The representatives present at the Conference will be invited to the Society's Conversazione, which will take place on the evening of the same day, at the South Kensington Museum, and will receive their cards on application at the Society's House on the day of the Conference.

CONVERSAZIONE.

The Council have arranged for a Conversazione at the South Kensington Museum, on Friday evening, the 12th June, for which cards will shortly be issued.

THE SOCIETY'S MEMORIAL OF THE PRINCE CONSORT.

The following additional names have been received up to the 14th inst.:—

Caslon, Henry William	1	1	0
Jackson, Samuel	1	1	0
Redgrave, Alexander	1	1	0
Whitelaw, John	0	10	6

DWELLINGS FOR THE WORKING CLASSES.

With a view to promote enlarged investments of capital in model dwellings and other establishments for the benefit of the working classes, the Council of the Society of Arts has instituted a statistical inquiry into the results hitherto obtained, including family dwellings of every description, model lodging-houses, dormitories, refuges, baths and washhouses, soup kitchens, coffee-houses, &c.

Members and others who can supply information or indicate sources where it may be obtained, are requested to communicate with the Secretary, who will send blank forms for being filled up with the required data.

COMMITTEES OF REFERENCE.

MECHANICS AND ENGINEERING.

The Committee met on Friday afternoon, 8th of May, Sir Thomas Phillips, Chairman of the Council, in the chair.

The CHAIRMAN opened the proceedings by briefly explaining the objects for which the Committee had been invited to attend. In response to the circular issued by the Council, those present had elected to be placed in the important division indicated by engineering in general, machinery, the principles of architectural construction, models, shipbuilding, and naval matters. That was undoubtedly a very wide field, and all that could be done at this preliminary meeting would be to ventilate, in some shape, any subject or class of subjects which they might desire to have considered, and, if thought desirable, to place them in train for further more definite and more systematic inquiry.

Rear-Admiral Sir EDWARD BELCHER said he thought one of the ways in which this Committee might be useful was in the formation of a list of subjects to which special attention should be directed. He knew it was the practice to print periodical lists of subjects for which premiums were offered by the Society, on which it was desired that papers should be communicated during the session.

Mr. TEULON would suggest the subject of the lighting of railway carriages as one which might be usefully considered by the Committee. Some time since they had a highly interesting paper and discussion in that room, in which the construction of railway carriages was incidentally touched upon. On that occasion he happened to differ from the writer of the paper, inasmuch as he did not think he was quite up to the present progress in railway construction. The Metropolitan Railway had recently been opened, on which a system of lighting the carriages with gas had been adopted. The same plan of lighting had been adopted on some of the longer lines, as for instance the Holyhead mail, and the mail between London and Dover, but as far as he had been informed, the methods employed were far from the perfection, which he thought was to be attained by the use of gas for these purposes. He would suggest that this was a subject which might be usefully selected for a premium. One point in particular he might mention, namely, that on the longer lines the gas was stored in one or two reservoirs, from which the lights in the train were supplied. Now it was clear that that was attended with inconvenience, because if from accident or other cause a train became separated, a portion of the carriages would be left in darkness, and the same inconvenience would be experienced in the case of the subdivision of trains on the journey. He believed in the case of the Metropolitan Railway each of the carriages, which were of very large dimensions, carried its own reservoir of gas, and he thought this was the best plan. Another point which might be usefully considered was the mode of burning fuel in locomotive engines. By modifications of those engines a large proportion of coal was now burnt, and those conversant with the subject would be aware that a given weight of coal could be used in place of the same weight of coke, at a saving of something like one-third of the cost. Great improvements had been made of late in coal-burning locomotives, but he thought further information on the subject might be usefully elicited. He believed the method was capable of still further improvement, for those who travelled behind coal-burning engines knew that they were occasionally incommoded by the large quantity of smoke emitted from them, which partly arose from want of proper care on the part of

the stoker. He begged to suggest these two points as being worthy of consideration.

Mr. SYMONS thought, looking to the present large consumption of the natural products of box-wood and ivory in many branches of manufactures, attention might be usefully directed to the finding of substitutes for those materials. He would suggest that a premium should be offered for the introduction of new products which could be substituted for articles which were getting scarce, and of very high price through their scarcity.

Mr. BOWER, with reference to the remarks of Mr. Teulon on the lighting of railway carriages with gas, said he was at the present moment particularly interested in that subject — the Great Northern Railway Company having afforded him opportunities for experimenting in in that matter. He agreed that the chief defect with regard to the lighting on the Metropolitan line, was the employment of gas at the ordinary pressure at which it was supplied from the gas holder into the reservoirs. The plan, if he rightly understood it, was, that there was a large outlet from a gas holder at the terminus, from which the reservoir, placed at the top of the carriages, could be charged with gas as often as was required; but with trains running long distances—from London to Edinburgh—a very different plan was necessary. In cases where lighting by gas had been adopted on long lines, the plan was that of having a reservoir at the end of the train connected with the carriages by tubes running along the top. Any accident to one of the tubes would leave a portion of the carriages in darkness. The only effective way of lighting a train, in his opinion, and which he was endeavouring to carry out on the Great Northern, was, that each carriage should have its independent supply of gas—but it must be done under pressure. In Paris, the portable gas was supplied to the consumers from cylinders, into which the gas had been compressed, and it was carried about in waggons, precisely the same as gas was supplied in London some thirty years ago. The gas in those cylinders was compressed to from fifteen to twenty atmospheres, and in that form supplied to customers who were beyond the range of the main pipes; and it was delivered into their reservoirs at about five atmospheres pressure. The difficulty, then, in the lighting of railway carriages, was to regulate the gas from five atmospheres to that which was equal to a column of water $2\frac{1}{2}$ inches high. Supposing they began with a reservoir containing $1\frac{1}{2}$ cubic foot compressed to twenty atmospheres, that would give 30 cubic feet of gas, and if the gas were made from Boghead coal or petroleum oil, they would have gas of four times the illuminating power of ordinary coal gas, and burning 1 foot per hour they would have three times the light of ordinary gas, which would make 30 feet of such gas equal to 90 feet of ordinary gas, and this would be sufficient supply for the three lights of a carriage for six or seven hours. In his experiments on the Great Northern Railway, he was trying to get over the difficulties he had referred to, and he hoped to announce to a future meeting that he had succeeded in accomplishing it.

Mr. CHRISTIE said he apprehended this was not a proper occasion to discuss this subject in its details, but he would state that the carriages on the Metropolitan Railway were not supplied with gas from the ordinary gas holder, but it was delivered into the reservoirs at a considerable pressure, and was supplied to the holders by hydraulic pressure. By this means the reservoirs of the carriages were filled very quickly, and to regulate the pressure to eight-tenths of an inch head of water was a simple matter.

Mr. CROMWELL F. VARLEY would refer to a matter of importance to Londoners in particular, and one which he thought worthy the attention of the committee. That was the protection of iron from rust, when exposed to the atmosphere. In his own profession he felt the effects of this very greatly in the neighbourhood of large towns, upon suspended telegraph wires, although that might be regarded as a small field for the use of iron. For the roofs of houses lead was generally used, but though it was expensive it was preferred on account of its non-oxydising properties. Considerable expense was also incurred in providing the necessary strength for supporting so weighty a material as lead. All attempts to use galvanised iron for roofs in large towns failed from the smoke attacking the galvanised metal, and tinned iron did not resist the action of smoke so well even as zinc. All the experiments he had seen of coppering iron had failed unless it was done in so expensive a manner as not to be practicable for any extended use of it. What they required was a covering of lead, or lead and antimony, put upon the iron so as to combine the stiffness and cheapness of iron with the durability of lead. Although this subject in connection with telegraph wires might not at first sight appear to be of any great importance, yet, owing to the multiplicity of those wires in the metropolis, the result might be that those who passed under them might be exposed to danger from the falling of long spans of wire through their being rusted away.

Col. SCHAFFNER thought the subject introduced by Mr. Varley was one of considerable importance. He had noticed the coverings of houses in different parts of the world. In some countries they were of tinned iron. In America this was largely used instead of lead. In St. Petersburg and Moscow iron was mostly used, but it required frequent painting. In the telegraph service he had tried many expedients for the preservation of the wires by galvanising, and the use of linseed and other oils. He had boiled the wires in linseed oil with beneficial results; but they would decay. It might appear a small matter at first sight, but its importance would be recognised when they considered that there were now in use all over the world some half million miles of wires for telegraph purposes, and when they looked at the inconvenience which was occasioned by the interruption of the communication thus established. With reference to the lighting of railway carriages with gas, that was no new thing. He had seen it done in America, as early as the year 1849, on the New Jersey and Georgia lines; and he had no doubt they would be able to obtain information from the other side of the Atlantic, which would save them the trouble of inventing plans for overcoming supposed difficulties in that respect.

Mr. C. F. VARLEY remarked, that galvanised telegraph wires lasted very well when not acted upon by the coal smoke of large towns. Wires suspended in the country, and free from such influences had lasted for 16 years. It was only in the large towns that the iron required to be preserved.

Mr. BLACKIE remarked, that the preservation of iron and steel from oxidation was important in connection with the delicate works of watches and chronometers, which required great skill to preserve them from rusting. Another direction in which it was important was with regard to the injury machinery suffered from the action of salt water; also in scales and other delicate mechanism. He thought a paper of a practical kind upon the prevention of rust upon metals would be of great benefit to them.

Sir E. BELCHER said in former times small arms were prevented from rusting by a simple process. The barrels were heated to such an extent as to burn stag-horn, which was rubbed over them, from which operation the old muskets received the cognomen of "Brown Bess."

Mr. BOWER said, that in lubricating machinery during the last two or three years he had found that petroleum oil, while acting as a lubricator, preserved the machinery from rust. With regard to telegraph wires, he thought there was a difficulty in applying oil in the way suggested to metal. In Paris, he believed, a preparation of copper was used with the petroleum oils to protect metals from rust, the copper being deposited by electricity and then made into a paste.

Mr. VARLEY, sen., remarked that iron, being porous, and an absorbent of moisture, had a great tendency to

decay upon atmospheric exposure. If iron were heated and passed through oil, the pores were filled up, and the metal lasted a long time. That plan of preservation from rust was brought before the Society of Arts many years ago. The preservative effects of the operation were shown upon comparison after eighteen months with other iron which had not been so treated. He believed the application of linseed oil to iron would be found very beneficial, and he had no doubt good results would be found from its application in the case of telegraph wires.

Mr. REVELEY mentioned, as the result of his own experience, that iron heated and covered with asphaltum or mineral bitumen in the solid state had resisted a moist atmosphere for 15 years. He had found the natural asphaltum the best, and he had not succeeded so well with liquid asphalte. With all other materials he had found the rust penetrated underneath.

Mr. JOHN BRAITHWAITE said this was a subject of great interest to him, and he might say his experience in it had not been small. With regard to the observations as to the preservation of iron by painting, it depended entirely upon the way in which it was done. His experience dated as far back as the year 1806, when, as a boy, he was employed with his father in the operation of clearing away the wreck of the *Lord Abergavenny* from the spot where she had foundered. It was found that the salt water produced a very rapid oxidation upon the iron work of the tackle used in that operation, and the mode of arresting it adopted by his father, and which he had himself followed for the last fifty years, was by painting the iron with red lead. Painting with white lead was of no use, as the acid used in the preparation of it produced the swelling effects which had been alluded to. About a fortnight ago he had inspected a well a little way out of London, where he had fixed an engine forty-five years ago. The severe test in all these matters was wind and water. The rods which had been placed in this well, 200 feet deep, were painted with pure red lead, and on taking them up, he had the curiosity to weigh them, and he found that their weight was precisely the same as when they were put down 45 years ago. The same preservative effects of red lead were apparent upon other iron work which had been many years in use. With regard to the remarks of the gentleman (Mr. Bower) who was experimenting with the lighting of carriages with gas on the Great Northern Railway, he would say, that not only was the matter to which he referred not one of difficulty, but it had already been carried out. He (Mr. Braithwaite) had constructed a condensing apparatus for carrying gas about like soda water, compressed to 15 or 20 atmospheres. That apparatus was employed for olefiant gas. There was no necessity for the pressure of 15 or 20 atmospheres. All that was required was to fill bags placed on the top of the carriages, on which a certain weight was laid, which would thus give the necessary pressure. On the Metropolitan line each carriage had a separate reservoir of gas, and the sack thus weighted was sufficient to light the carriage for a short journey.

The CHAIRMAN then invited suggestions upon the next division of the subject, Naval Architecture.

Sir E. BELCHER said the subject to which he had been applying his attention, and on which on a future occasion he might be prepared with a paper was, the effective construction of ships of war, but not of iron, for he saw no necessity for iron vessels in the navy. He entertained the idea that he could construct wooden vessels with coppered bottoms suitable for war, and impregnable during the time of any action, and thus bring the old wooden ships into service.

Mr. D. K. CLARK said, reverting to the Metropolitan Railway, the chief consideration was to get a better mode of propulsion adapted to the circumstances of that line. The great object was to get a locomotive which did not make any smoke, and that could be done by carrying reservoirs of steam and hot water with the train, which would give off steam spontaneously for a certain length of time, or it might be done with compressed air. Another subject for consideration was the more general use of coal in locomotives, and consuming the smoke emitted. He agreed with Mr. Teulon that, although coal could be used without smoke being emitted, this was not carried out in practice. A still more important question was to reduce the price of coke, so that, assuming the evaporative power of coke to be the same as that of coal, if they could reduce the price of coke to that of coal, it would be much better to use coke. Coal had been introduced solely on the score of economy, but upon that point it was open to question, looking to the effects of the smoke upon the carriages and other parts of the train, involving a larger expense for cleaning and maintaining. He thought the direction in which the reduction of the cost of coke was to be looked for was in the utilisation to a greater degree of the gaseous products which were now wasted in the process of coke manufacture. They knew that the products of coal distillation were utilised in various ways. If they could preserve the gases and convert them to some useful purpose the price of coke would be greatly reduced. He thought these were legitimate subjects for inquiry by the committee. Another question for consideration was the reduction of the friction in the rolling stock, and the consequent reduction of the power necessary to propel it. Friction was a matter involving great cost, and under that head would be involved not only the construction of the carriages, but the lubricants employed.

Mr. BRAITHWAITE said, with reference to Mr. Clark's remarks upon the subject of engines for the Metropolitan Railway which emitted no vapours, this could be effected by means of compressed air, and, at the present moment, an engine was working the tunnelling apparatus at Mont-Cenis, which would be applicable to the purposes of an underground railway. The Parsey engine was no doubt familiar to all present, and he (Mr. Braithwaite) had recommended it in the excavation of the great tunnel through the Alps. There was this great benefit from it, that it was a means of thoroughly ventilating the tunnel to its furthest extremity, and getting rid of all the deleterious gases that were generated. The ventilation of railway tunnels was a subject of increasing importance, and in the case of the Mont Cenis tunnel, the workmen employed breathed as pure oxygen as in the open air, and that which gave the mechanical power furnished a thorough means of ventilation. To show them how little regarded was the subject of lubricants, he mentioned that having heard of a new axle-box for the saving of grease which had been invented by a Frenchman, he inquired into it, and found that it consisted of the application of water in contiguity with grease, and was a most economical as well as effectual means of lubrication. He introduced the new axle-box to the notice of his brother engineers, and to several railway companies, but though it was shown that, by its use, half the consumption of grease would be saved in some cases, no notice was taken of the matter. He, however, obtained permission to put these axle-boxes upon carriages on the Great Western, the South-Western, and the South-Eastern. The axle-box was of the kind ordinarily used, but it had an outer casing in which water was allowed to mix with the grease when lubrication was wanted. He had fitted a set of these axle-boxes to a goods break carriage, on the London and North-Western Railway, in the month of September, and they continued in working up to the following April without any fresh grease having been supplied. Notwithstanding this manifest advantage in the saving of grease, the invention had been allowed to drop. As to the generation of steam, that was a matter which the committee would do well to consider. At present engineers were not satisfied with 16 feet of heating surface per horse-power, but they were trying for 25 or 30 feet; but if they got that surface they must have something to contain it. He maintained that a horse-power of steam might be got out of a foot of surface. He had illustrated that principle in his engine known as the

"Novelty," and in steam-navigation this was a point of great importance.

The committee then separated.

TWENTY-SECOND ORDINARY MEETING.

WEDNESDAY, MAY 13, 1863.

The Twenty-Second Ordinary Meeting of the One Hundred and Ninth Session was held on Wednesday, the 13th inst., Chandos Wren Hoskyns, Esq., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Drake, Henry	24, Duke-street, Westminster, S.W.
Eales, Christopher	9, Welbeck-street, Cavendish-square, W.
Edney, William	38, Finchley-road, St. John's-wood, N.W.
Elliot, Russell	101, Long-acre, W.C.
Elt, Charles Henry	1, Noel-street, Islington, N.
Hammick, James Thos.	Census Office, Craig's-court, S.W., and 6, Winchester-road, Hampstead, N.W.
Roper-Curzon, Hon. H.	47, Argyll-road, Kensington, W.
Smith, W. H.	150, Leadenhall-street, E.C.
Taylor, John	Egremont-villa, Lower Norwood, S.

The following Candidates were balloted for and duly elected members of the Society:—

Dickson, Lieut.-Colonel Lothian Sheffield	10, Stanhope-terrace, Hyde-park, W.
Donaldson, Sir Stuart, Bart.	22, Rutland-gate, S.W.
Guthrie, Thomas Anstey	7, St. George's-terrace, South Kensington, W.
Maurice, Joseph	3, Langham-place, W.
Stansfeld, Josias Logan	Hersham, Surrey, and Reform Club, S.W.

The following Institution has been received into Union since the last announcement:—

Bolton, Mechanics' Institution.

There were two Papers read; the first was—

ON AN IMPROVED MODE OF COLLECTING EXCREMENTITIOUS MATTER, WITH A VIEW TO ITS APPLICATION TO THE BENEFIT OF AGRICULTURE AND THE RELIEF OF LOCAL TAXATION.

BY J. L. W. THUDICHUM, M.D., F.C.S.

When the House of Commons, in the course of last Session, resolved to appoint a Committee for the purpose of inquiring into "The best means of utilising the sewage of towns with a view to the reduction of local taxation and the benefit of agriculture," it proposed to re-open the inquiry into a matter which, as was evident from the Parliamentary Return on the drainage of the metropolis of the year 1857, had already been proved to be impracticable by the most ample analytical proceedings of men of science, and costly failures of private and public enterprise. To those, therefore, who were acquainted with all the bearings of the question, the result of the inquiry, so far as its purpose was expressed in its programme, could not for one moment be doubtful. To those, however, who believed that the inquiry could not be limited to the subject of its title, a way appeared open by which the object might be attained. This belief was founded on the conviction that the excrements of man are of the greatest value to agriculture; that by the present system of house and town drainage they are lost; that their removal involves a tax upon the community; and that by their discharge into rivers they pollute them and make them nuisances and sources of disease. The conclusions to which this conviction should have led all inquirers are of so simple a nature, and arrived at by so short and straight a way, that it is a matter of astonishment how they were missed by those who were called upon to give the results of their experience, or who volunteered their views.

The attempt to deal with the matter in question perished in the use of the word "sewage," just as the material which it was desired to preserve perished in the complex mixture called sewage. Sewage was assumed to be an unalterable entity, a decree of fate, from the very moment that those who proposed to deal with it lost sight of its real nature, as a foolish and shortsighted manufacture of man. The recognition of this error constituted the first step towards the only possible solution of this question; it led to the conviction that a return to first principles was absolutely required before the excrements of man could be utilized for either of the two laudable objects of the resolution of the Commons. As sewage contains nothing that is valuable for agriculture or any other human purpose beyond the excrements of men and animals, the inquiry of the Commons should properly have been into the best mode of utilising human excrements for the purposes indicated in the resolution. But this inquiry could not come before them, or occur to their mind's eye, unless another was previously instituted by them into the manner in which human excrements could be collected so as to allow of being applicable to any purpose whatsoever. Deliberation on this subject, however, became very difficult, owing to that false delicacy of modern society, which endeavours to remove such matters altogether from its notice, and through the very reasonable apprehension that any change in the present arrangement would involve expense and the abandonment of a comfort which all educated persons consider as a necessity of life; for the only alternative which was seen was between retaining the present closet and its apparatus, and returning to the cesspool just got rid of by legal enactments. The just abhorrence in which this inexpressible chamber, with its smells, its diseases, its contaminations of every kind, was held, left no doubt that all comfort-loving persons would pronounce for the retention of the hydraulic apparatus, even at the cost of an annual loss of five millions of value, and an additional expenditure of five millions of money for guano and artificial manure, and many millions more for the purchase of the grain and meat of other countries.

To a man who argues, as a common man would express it, by contraries; to that independent inquirer who investigates the circumstances which speak against his opinion, rather than those which appear in its favour—to such a man it must appear that the inventor of the closet-pan performed an experiment expressly for his use. Supposing him to have inquired into the intentions of Nature, and supposing him to have tested the logic of the question by trying how he could defeat the objects of Nature, he would immediately have fallen upon the closet-pan. But as men generally were not thus independent and thoughtful, their estrangement from Nature and her provisions could be effected by a gradual process of breaking their minds to the tolerance of loathsome places and of foolish processes for their use. First was erected the enclosure termed the privy; then came the wooden seat with the round hole in it; at first it was kept detached from habitations, until when the habitation was deprived of surrounding space, and became a town house, the necessary

room, with a cesspool attached, became part of the habitation. Then to guard his habitation from the contamination which he had himself necessitated, man flew to the water-closet, and robbed his field of its resources and nature of her due.

This was so little a result of unavoidable circumstances that, on the contrary, it must have involved a total forgetfulness of the oldest habits and laws of mankind. The Jews in the Desert had the spatula,* with which each man dug a hole for his fæces on the top of the declivity down which he had determined that the urine should flow. Thus was Moses great as the greatest of the givers or upholders of natural sanitary laws. The rediffs in the Turkish camp used, in the beginning of this century, to avail themselves of a similar arrangement. A hole was dug in the ground, and a tent was placed over it; slabs of stone formed a footing, and left a narrow canal between; the hole received the solid, which was immediately covered by a shovelful of the available earth close by. The fluid excretion ran by a narrow ditch to where it sunk into the ground. The proper working of the arrangement was insured by the vigilance of a sentry deputed for the purpose. Even the instinct of animals has taught reasoning man a lesson of cleanliness by the burial of their ordure. But neither from his ancestors nor from those whom he despised as inferior in what he called civilisation, nor from the brute creation, did the western man, the man of the Christian era, take example. At first he dirtied everything by what he cast from himself. He next removed pollution a little further from his habitation by sending it into his rivers; but, by a retribution of Providence, it turned back upon him in the water which he required for washing and drinking.

This state of affairs is recognised by all to be a matter of the greatest reproach to our generation; and, consequently, all would willingly remedy the evils if the means for doing so were but found. The subject is now no longer beneath the notice of statesmen, and industrious citizens even cater for the applause of vestrymen by flattering their hopes for cheaper bread and lesser taxes. Royal Commissioners have travelled through the land and taken notice of the cry of the populations—of the bills of disease and mortality, of the experiments of the industrious or the schemes of the speculator. The highest tribunal of the kingdom at last has recognised, by the appointment of a Committee of Inquiry, that the subject is of national importance, and is fully aware that it would meet with the unanimous support of the people in town and country if it were to encourage, by legal enactments, a feasible plan for escaping the reproach of recklessly throwing away what everyone knows must constitute the wealth of the nation.

We are now in possession of the final reports on these inquiries, and are fully able to estimate their shortcomings and their merits. Whatever may be the judgment of other persons upon their nature and results, in us they have produced the conviction that the purpose indicated in their title is still unfulfilled, that they contain no account of a proceeding in actual operation by which agriculture is benefited, or local taxation reduced, nor any suggestion by the carrying out of which those objects are likely to be attained.

The question is, therefore, open to original investigation, and as the result of such I beg to bring forward the following proposition.

By way of showing my basis, I must enunciate a principle which is, indeed, nothing else but the application to our subject of the principle upon which natural things must, at all times, be investigated. In inquiring into the best means of collecting human voidings, and applying them to beneficial and profitable uses, we must have the closest regard to the ways and objects of nature, to the mechanical arrangements by which she removes refuse matter from the human body, and to the chemical peculiarities with which she has endowed the solid part on the one hand, the fluid part on the other.

Nature separated these two excretions by propelling them in directions which diverge at an angle of 45 degrees, more or less. This arrangement makes it an easy task for a practical mind to adapt an apparatus to the necessities of man, and for man to adapt his position to the apparatus.

The separation of urine from fæces by means of an apparatus is, however, a very subordinate point in the main question at issue. By far the greater quantity of urine, among it that which is most important for the purpose, the night and morning urine, is passed at times and into vessels quite independently of defæcation. It may be said that five-sixths of all the urine passed is voided into chamber-pots and urinals, or might at least be voided into either of these receptacles with less trouble than into any other. One-sixth part of the urine at the outside is passed during the process of defæcation.

Nature then, by ordaining the discharge of urine at frequent intervals quite independent of defæcation, and by restricting the quantity discharged with defæcation to less than one-sixth part of the total quantity discharged, has imposed a kind of compulsion upon man to collect this excretion in a separate vessel. We at once perceive that the chamber-pot is a penny savings-bank, that the large amount of matter deposited daily therein must be collected and united to a larger capital, with which to fertilise the fields and secure the independence of agriculture.

Collection of the Urine.

The arrangements for this purpose, in the first instance, are such as to keep the urine uncontaminated by water, slops, or other impurities. All these should go directly into the place of their final destination, or take the intermediate route of the slop-pail. This purity once secured, the urine becomes a matter easily to be dealt with. It loses entirely the repugnant appearance and attributes which bad habits have associated with it; and what is of the greatest importance, it loses that aptitude to ammoniacal decomposition which the admixture of other matters readily engenders. This in its turn prevents the incrustation of vessels, which otherwise so easily ensues, and in this manner one step secures a series of consequences all favourable to our purpose, promoting domestic comfort, and diminishing household labour. The common slop-pail, for example, which through the almost unavoidable incrustation with lime-salts of the fatty acids from soap, and by the imbibing of this crust by ammoniacal substances, frequently becomes a nuisance on a small scale, is, by this means, converted into a clean and inodorous receptacle.

But as the contents of the vessels intended for the reception of the urine are emptied at least once a day, more commonly twice a day, and in some cases more frequently during the 24 hours, and as it would be very inconvenient to carry every vessel to the place where its contents are finally sent out of the house, it becomes necessary to employ a separate large vessel for collecting the contents of every smaller one of the house and carrying them therein to the place of egress. This larger vessel is of the shape and size of a common slop-pail, with a moveable sunk lid, serving as funnel and filter, with a spout for pouring out its contents, and a fixed handle at the side opposite the spout to hold it by during the pouring out the contents, and an arched moveable top handle for carrying it. This vessel may be termed the chamber-pail.

By means of this chamber-pail every householder has it in his power to cause five-sixths of the valuable fluid excreta to be collected, and to be further disposed of at his absolute will and pleasure. If he purchases a cask or an iron tank, and causes them to be trapped by the easiest means, so that no smell can be evolved by any chance, he may collect any quantity during any length of time he pleases, and at suitable periods either apply the contents of the cask or tank to his own lands, or sell them to

* Deuteronomy, xxiii. 12.

the agriculturist, to be disposed of by this latter according to his convenience. The householder can in this way, without any particular trouble in the course of each year, collect urine to the value in money of 10s. per head; from which it is evident, that the produce of the first year's collection in an average family of five persons would more than repay the cost of the whole apparatus, chamber-pail, cask, or tank, removal and application to the land. The farmer, on the other hand, would buy only what was really of value, as he could for a trifling sum ascertain to the utmost farthing the amount of matter valuable for his purpose contained in a given quantity of collected material. The second and all following years would return to the householder the full revenue of ten shillings per head of his household.

Of the daily urine passed by the inhabitants of London, a quantity of 2,900 tons, of a value of £2,838, could by these means be collected every day. The simplest arrangements, which need not exceed a few pounds in expense for every house, would enable the inhabitants of London to collect a value of a million pounds sterling per annum, without offence to their health, their noses, or even their feelings. The same holds good for every other town, or village, or single house; everywhere a value of ten shillings per head can be collected and returned to the land from which it was abstracted. Even if legal enactments could not be obtained for the plan, which I shall hereafter submit, for the collection in one spot of the excretions of entire communities; if no board of works could be moved to allow the sewers to perform their most valuable function, and assist in producing a return to the burdened tax-payer, even in that most improbable case, an expense of sixteen shillings for every house, sunk in the purchase of two carboys and a chamber-pail, would enable a society of private individuals to collect, with the concurrence of intelligent householders, value to a very large amount, and return to the householder, say one-half of the profits after deducting sinking fund on capital, interest, and cost of removal and application or transformation; and such half of the profits would in all cases amount to a considerable portion of the sewerage rates, and if every householder would do his duty fully, the whole amount of his sewers rates might be saved by his energy and industry.

But for towns provided with a system of sewers a much cheaper plan for collecting the urine of the population can be adopted, by providing a system of pipes, one from every house, which entering the sewer by the drain shall there be connected with a main, the main to meet its equals at the junctions of the sewers to combine with larger mains, and the whole to conduct their fluid contents to suitable stations in the course or at the outfalls of the sewers. At the stations or outfalls the urine might be collected in tanks, and carted away by road and rail, or lifted in stand-pipes, and sent to any distance by a system of conduits and reservoirs in the country, or be transformed into a concentrated, highly valuable, dry, portable manure. Even in towns where there are no sewers, or where only the smaller number of houses drain into the sewers, a system of pipes might be laid down and a profit realised upon the collection and removal of the excretions. Thus the town of Birmingham, which now expends upwards of £8,000 per year to clear the privies of its population of filth of little value, could by carrying out this proposition make an income of at least the amount of its present expenditure, possibly to the amount of £100,000, a sum still far below the theoretical value of the fluid excretion of its population.

The details of this proposed arrangement are no less simple than its general features. Excluding at present the consideration of the improvements which might be adopted in the construction and working of water-closets, we have only to provide one stationary outlet for the contents of the chamber pail. This is a funnel, leading to a pipe, of lead, bent in the usual manner so as to preclude the possibility of the regurgitation of any gases that might be evolved in its continuity. The funnel must be moveable, so as to admit of being cleaned by hot water. The pipe to which it leads must, moreover, in the better class of houses, admit of being closed by a cock or plug provided for the purpose. This funnel, termed the chamber funnel, conducts the urine through the bend into a small tank or reservoir, which can be opened occasionally for gauging the contents, and allowing the taking of a sample to test the purity and amount delivered. From this tank, which can be let off periodically, a half-inch pipe runs through the house drain into the sewer, there to join the main.

The main, which receives the pipes proceeding from the single houses, is an iron or stoneware pipe running along the wall of one side of each sewer a little above the mark of the ordinary dry-weather flow of sewage. The pipe is supported and fixed by cast-iron bearings let into the brickwork. It is somewhat egg-shaped on a section, with a flat and removable top-lid, which can be fixed water-tight, or removed in case any obstruction should require the interior of the pipe to be examined. The probability of the occurrence of obstruction in the main from calcareous deposit is very small indeed, and in portions where there is a rapid fall, closed round pipes can be used without hesitation. But as some engineers whom I consulted were apprehensive of incrustation, it is but right to take notice of their objections. The incrustation of common sewage pipes in the Fulham experiment has no bearing whatever upon the behaviour of uroducts in the sense here propounded. Sewage is alkaline; urine, acid; sewage contains lime-salts of fatty acids from soap, which adhere to any article they touch, and cause incrustation with great readiness, as can be learned by the observation of any slop-pail. The example of public urinals is also no guide towards a conclusion as to the effects of urine in the main. The urine is there spread over a large surface, and allowed to dry in part and to decompose. The earthy phosphates are thereby deposited and form incrustations by the crystallisation of the ammoniaco-magnesian phosphate. This retains decomposed urine, which acts as a ferment to all following portions of healthy urine. Deposit and ferment might easily be removed by the application of a little dilute nitric acid, mixed with some nitrous acid, and one daily careful washing. The main, so far as it is of lead or earthenware, can be freed from all deposit by the occasional application of some hydrochloric acid; the iron main would suffer by this agent, and when the most improbable case of its obstruction by phosphatic deposit should arise, might be cleaned by mechanical means.

The size and capacity of the mains must be calculated for every sewer according to the number of persons living in the houses draining into it. Supposing that the urine of the part of London north of the Thames were destined to collect in three mains, lying in the three intercepting sewers on the high, middle, and low level, a pipe one foot in diameter in each of them would admit of the gravitation of the whole of this vast quantity of daily excretion towards a common or three different receptacles, without there ever being any pressure in any of the pipes. But the possibility of such a pressure even can be provided against by a few perpendicular pipes rising from the top of the main, and admitting of the escape into the sewers of any casual excess of fluid.

As the main has to be fixed at the side of the sewer, where it would not obstruct the flow of the sewage, nor assist in the formation of deposits, and would also be out of the way of the persons who have to pass through or to work in those canals, it would be necessary to conduct the pipes from the houses lying on the side opposite to that side of the sewer along which the uroduct runs, across the sewer. This is best done in the form of an arch running along the roof of the sewer, and descending into the uroduct. As in the great majority of houses the level of the chamber sink would be above the level of the top of the sewers, this arrangement would offer no hydraulic difficulty.

PERMANENT SEPARATION OF URINE FROM FÆCES.

There is an arrangement by which that part of the urine which passes during defæcation can be collected and united with the other five-sixths of the total quantity. It consists of a common water-closet, with merely a peculiar pan, being divided in two parts, an anterior one for the reception of the urine, and a posterior one for the reception of the fæces, in the usual quantity of water. The special arrangements for flushing with water both parts of the pan, and the proportions of those parts, must be left for special description, and are best understood by an inspection of a model or of the pan itself. Suffice it to say that the anterior funnel conducts the urine into a pipe, which, after having formed the usual ᔕ shaped bend, passes downwards along the large closet pipe, or coproduct, and in or near the drain joins the pipe coming from the chamber sink, or passes into the urine-tank. The posterior division is provided with a valve in the usual way, and washed with water in the usual way. An ounce or two of water only is provided for washing the anterior funnel of the uroduct.

This simple arrangement was indicated by me many years ago, as can be seen from its description in my work on the "Pathology of the Urine." It was also elaborated in France; and the water-closets of the building of the Exhibition of Paris, in the year 1855, were actually provided with it. The pans (terrines) worked exceedingly well, and there are many persons in London who can testify from personal experience as to their perfect success in the operation for which they were intended. A French chemist, M. Chevallier, obtained two prizes in the French exhibition for a similar pan. He did not, however, exhibit his article in the last London exhibition. A Swede however, a M. Klemming, from Stockholm, exhibited portable closets, in which the separation of the urine from the fæces is effected by a divided pan, the receptacle for the urine being trapped by a bent tube, and the aperture for the fæces by a valve, which opens when the person sits down upon the top ring, and closes when the operation is completed and the person leaves. Of this Swedish manufacture I possess a very excellent specimen. In the North it is generally known under the name of "Marino's closet."

MODE OF SEPARATELY COLLECTING BOTH URINE AND FÆCES.

This arrangement for carrying out the intentions of Nature as to the separation of the fæces is, however, of much more importance in houses where no water-closets as yet exist, and the fæces and urine together pass into common receptacles, drains, or cesspools. Here the receptacles have simply to be divided, or two separate moveable receptacles have to be substituted—the one, a cask, a tank, or a carboy, to receive the urine from the uroduct; the other, a wooden box, a cask, or an iron box, to receive the dry fæces, dried further by the admixture of certain simple agents, inexpensive and within reach of everybody. The pan forming the funnel of the coproduct, is, in this arrangement, either provided with a valve at the bottom, or divided into two lateral halves, which open when a handle is pulled, and let the contents pass into the box below, whose cover opens by the pull of the same handle, and closes again when the pan closes and the handle is down.

The succession of the single steps of defæcation with this machine is as follows:—A conical paper bag made for the purpose is placed in the pan, or a paper spread over its bottom valves. A little dry earth, or a mixture of earth and lime, or of earth and gypsum, or of earth, lime, and gpysum, or of lime alone, is by means of a scoop from a common skuttle placed in the bag; the excretory process next deposits the fæces upon the earth, the urine being propelled into the uroduct. The operation, including deposition of papers, completed, another quantity of earth, or mixture of earth and lime, is thrown upon the fæces, whereby they are completely deodorised; the valve is drawn, the bag and contents fall into the box below; the valve closes, and all is finished. Those who are very particular can fix a small suction and pressure pump to flush the funnel for the urine with an ounce or two of water. It would perhaps be still better to have the pan made so that it can easily be removed and cleaned in a place where the water does not flow either into the coproduct or the uroduct.

The urine not touching the fæces, the amount of smell which rises from the fæces is not increased by the carriage of the steam which rises from the urine. The scybala are finally deodorized by matter, which being alkaline, combines with their mostly acid parts, and are preserved from decomposition by the substraction of moisture effected by the lime and dry earth. Both receptacles can be removed entire and fresh ones substituted, or their contents may be emptied into larger ones as often as may be requisite by the accumulation of matter, without difficulty, smell, or annoyance of any kind. The fæces and earth can be deposited upon any land, or in any dung-pit, upon any compost-heap, or be dug in or ploughed under the earth immediately; the urine, also, may be immediately distributed on land, or collected in tanks and reservoirs to await the opportunity of its direct use or its transformation into a portable manure.

The process here indicated is only the continuation of the process adopted by nature, and the agency employed is of the simplest and easiest kind, and its materials are either ready furnished by nature, or easily obtained by art in the largest quantities. The greatest difficulty, namely, the collection of the fæces without dirtying a receptacle requiring the agency of water for cleaning, is met by the adoption of a receptacle which may perish with the matter which it receives. Earth, moist or dry, or dried common earth, the most powerful hygroscopic substance known, surpassing even sulphuric acid and absolute alcohol in its affinity for water, is used to mummify the fæces, which at the same time are touched by lime to neutralise their acid properties and arrest their decomposition. The odour actually present is also absorbed by the earth, and the development of any further odour is precluded by the combination and dessiccation. This process is eminently adapted to satisfy the requirements of single houses in the country, of villages, and small towns. Many of the eleven-twelfths of the houses of Birmingham and Manchester not yet provided with water-closets, can apply this new apparatus at small cost, and sell the whole of the yearly proceeds at the rate of twelve shillings for every adult person. To the more densely-populated parts of larger towns, and the dense parts of London, this dry process is, however, at present not so applicable as the water-closet with the funnel and uroduct, and the chamber-pail and uroduct within the sewers.

The following tables prove by special calculations the correctness of my general propositions. The data of which they are composed are the best that the literature of science can afford, and are for the time complete. A few points could no doubt be ascertained more closely by renewed investigation, but, on the whole, the changes that could be effected thereby may confidently be pronounced beforehand as quite immaterial.

FIRST SERIES.—I. TO XVI.

SHOWING THE PHYSIOLOGICAL QUALITIES OF URINE AND INGREDIENTS DISCHARGED BY BOTH SEXES AND VARIOUS AGES*:—

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* E. A. Parkes, M.D., "The Composition of the Urine in Health and Disease," 1860. J. L. W. Thudichum, M.D., "A Treatise on the Pathology of the Urine," 1858.

TABLE I.

AVERAGE DAILY QUANTITY OF URINE PASSED BY HEALTHY ADULT MALES BETWEEN 20 AND 40 YEARS OF AGE.

The number of days furnishing the mean is in no case less than six.

Observers.	Amount in fluid ozs.	Observers.	Amount in fluid ozs.
Prout	35	Valentin	50
Bird	38	Kerner	52
Schirks	38	Bischoff	54
Hammond	39½	v. Franque	54
Parkes	40*	J. Vogel	57
Becquerel	44	Beneke, 2nd observation	59
Lecanu	44	Beigel	59
Roberts	46	Thudichum	61†
Schneller	46	Mosler	65
Genth	47	Jul. Lehmann	67
Kaupp	47	C. J. Lehmann	71
Beneke	49	H. Ranke	71‡
Neubauer	49	Boecker	81‡

Mean in 24 hours ... 52½
Mean per hour ... 2 1/10

* Mean of 20 days' observation on one person (in London?)
† Mean of 163 observations on two persons in London.
‡ Mean of 30 observations on one person.

TABLE II.

AVERAGE DAILY QUANTITY OF UREA VOIDED BY HEALTHY ADULT MALES BETWEEN 20 AND 40 YEARS OF AGE.

Average of not less than six days each, often ten to twenty.

Observers.	Amount in grains.	Observers.	Amount in grains.
Becquerel	286·1	J. Vogel	540·0
Parkes	371·5	v. Franque	541·3
Beneke	378·2	Bischoff	541·9
Scherer	416·8	Beigel	551·0
Lecanu	432·3	J. Lehmann	551·8
Moos	444·6	Mosler	558·9
Boecker	444·9	Rummel	563·6
Schneller	458·2	Kerner	588·2
Scherer (2nd series)	460·4	Ranke	656·0
C. J. Lehmann	501·6	Hammond	670·0
Neubauer	511·2	Genth	688·0
Kaupp	535·1		

Mean in 24 hours ... 512·4
Mean per hour ... 21·0
Nitrogen ... 46·667 per cent.

TABLE III.

AVERAGE DAILY QUANTITY OF URIC ACID, CREATININE, XANTHINE, SARKINE, HIPPURIC ACID, AND OTHER MATTERS DISCHARGED BY ADULT HEALTHY MALES OF BETWEEN 20 AND 40 YEARS.

Boecker estimated the total of these at 247·6 grains.
Scherer ,, ,, 375·7 ,,
,, in a second case ,, 318·0 ,,
Rummel ,, ,, 236·7 ,,
Becquerel ,, ,, 180·0 ,,
Parkes, deducting volatile salts, uric acid estimates extractives at 154·0 ,,
These matters, in women of 15 to 40, 149·0 ,,

TABLE IV.

AVERAGE DAILY QUANTITY OF CREATININE EXCRETED BY HEALTHY ADULTS.

Observers.	Amount in grains.
Thudichum	12
Neubauer	14·6 mean (9·2 min. 20·0 max.).

Nitrogen, 37·17 per cent. = 4·46 gr. which may yield 5·41 gr. of ammonia.

TABLE V.

AVERAGE DAILY QUANTITY OF URIC ACID EXCRETED BY HEALTHY ADULT MALES.

Observers.	Amount in grains.	Observers.	Amount in grains.
Neubauer (1st obs.)	4·32	J. Vogel	7·72
Beneke	5·40	Kaupp	8·01
J. Lehmann	6·11	Genth	9·35
Schulters	6·79	Ranke	10·00
Neubauer (2nd obs.)	7·56	C. J. Lehmann	10·80
Becquerel	7·64	Hammond	14·14
Boecker	7·64	Kerner	14·94

Mean ... 8·57

Nitrogen, 33·33 per cent. = 2·85 grains, which after putrefaction might yield 3·46 grains of ammonia.

TABLE VI.

AVERAGE DAILY QUANTITY OF HIPPURIC ACID EXCRETED BY ADULTS.

Observers.	Amount in grains.	
Liebig	9	"In about the same quantity as uric acid" (8·57).
Lehmann	9	
Weismann	34·5	when living on mixed food.
Ditto.	17·	when living on animal food.
Bence Jones, 1st indiv.	4·9	average of three days.
Ditto. 2nd indiv.	6·5	average of four days.

TABLE VII.

AVERAGE QUANTITY OF PHOSPHORIC ACID EXCRETED BY HEALTHY ADULTS IN TWENTY-FOUR HOURS.

Observers.	Amount in grains.	Observers.	Amount in grains.
Neubauer (1st obs.)	24·70	Sick	47·26
Dunklenberg (1st obs.)	32·94	Neubauer (3rd obs.)	47·86
Kaupp	35·46	Genth	49·33
Dunklenberg (2nd obs.)	35·62	Kerner	52·75
Mosler	36·48	Krabbe	52·85
Beneke	39·21	J. Vogel	54·04
Neubauer (2nd obs.)	39·94	Breed	57·62
Ranke	41·53	Winter (1st obs.)	57·92
Aubut	43·23	Winter (2nd obs.)	65·13
Hammond	43·66	Hegar (2nd obs.)	71·63
Boecker	45·13	Mosler (2nd obs.)	75·81
Beneke	45·46	Winter (3rd obs.)	79·07
Hegar (1st obs.)	45·57		

Mean... 48·83

This gives for one million persons per annum 1,135·8 tons, value at £14 per ton (1½d. per lb) £15,902 12s.

TABLE VIII.

AVERAGE QUANTITY OF SULPHURIC ACID EXCRETED BY HEALTHY ADULT MEN IN 24 HOURS.

Observers.	Amount in grains.	Observers.	Amount in grains.
Becquerel	17·34*	Gruner	32·33
Parkes	20·67	Buchheim (2nd case)	32·50
Kaupp	21.03	Krause (2nd case)	35·05
Beneke	24·70	Boecker	35·56
Krause (1st case)	26·57	Kerner	38·26
Buchheim (1st case)	26·88	Neubauer	38·29
Duhmberg	28·85	Hammond	38·47
Neubauer (1st case)	29·79	Mosler	40·91
J. Vogel	30·88	Genth	41·14
Clare	32·02		

Mean ... 31·11

This for two million adult males gives 4 tons per day, value £37 6s., at 1d. per lb., or £9 6s. 8d. per ton.

* Probably too low, from loss during incineration.

TABLE IX.

AVERAGE QUANTITY OF CHLORINE EXCRETED BY ADULTS IN 24 HOURS.

Observers.	Amount in grains.	Observers.	Amount in grains.
Parkes (1st case)...	57·87	Neubauer ...	136·87
Parkes (2nd case)...	58·05	Wilde ...	147·60
J. Vogel	92.06	Hammond ...	154·80
Buchheim (1st obs.)	105·45	Kaupp ...	155·94
Buchheim (2d obs.)	105·60	Kerner...	156·71
Mosler	108·23	Hegar ...	161·96
J. Vogel	123·52	Beneke...	162.12
Bischoff	134·32	Genth ...	173·23

Mean ... ... 126·76

Corresponding to chloride of sodium ... 210·0

This, for one million men per year, gives 4888·3 tons, at ½ per lb., or 92s. per ton, has a value of £22,486.

TABLE X.

AVERAGE QUANTITY OF AMMONIA DISCHARGED BY ADULT HEALTHY MEN IN 24 HOURS.

Neubauer	12·8*
The same	9·5†
Boecker	6·48
Kerner	12·8
Mean...	10·52

* Mean of 12 experiments upon a man aged 30.
† Mean of 12 experiments upon a man aged 20.

TABLE XI.

AVERAGE AMOUNT OF POTASH IN URINE OF HEALTHY MEN.

Observers.	Quantity in grains.
Becquerel...	25·36*
Genth	107·17
Bœcker	40·5
Mean	58·2

One million men will therefore yield per year 1354·7 tons, value at £32 per ton, £43,350.

* This is probably too low, from mode of analysis employing incineration, by which potash is volatilized.

TABLE XII.

AVERAGE AMOUNT OF LIME AND MAGNESIA IN THE URINE OF HEALTHY ADULTS IN 24 HOURS.

Observers.	Grains of Lime.	Grains of Magnesia.
Neubauer	2·90	3·08
Duhmberg	6·36	4·21
Wagner	2·62	2·66
Genth	2·33	2·53
Mean	2·33	3·12

TABLE XIII.

AVERAGE QUANTITY AND COMPOSITION OF THE URINE OF 20 ADULT FEMALES BETWEEN 16 AND 40 YEARS OF AGE.

Observers.	Ingredients.	
Becquerel... Lecanu ... Bischoff ... Mosler ... Beigel ... Ranke ...	Water	42 fluid ounces.
	Urea	390·0 grains.
	Uric Acid	7·3 ,,
	Chlorine	98·9 ,,
	Sulphuric Acid ...	30·2 ,,
	Phosphoric Acid ...	56·2 ,,
	Extractives, bases, and other ingredients ...	149·0 ,,
	Total Solids ...	731·6 grains.

TABLE XIV.

AVERAGE QUANTITY AND COMPOSITION OF URINE OF CHILDREN OF FOUR YEARS TWO MONTHS OLD, AND 31 LBS. WEIGHT.

Observers.	Ingredients.	
Scherer ... Rummel ... Bischoff ... Lecanu ...	Water	23 fluid ounces.
	Urea	178·8 grains,
	Extractives and Volat. Salts	60·7 ,,
	Mineral Salts ...	186·9 ,,
	Total Solids ...	426.4 grains.

BOYS FROM 3 TO 16 YEARS.

Observers.	No.	Age.	Weight.	Urine.	Urea.	Na. Cl.
			lbs. avoir.	ounces.	grains.	grains.
Rummel Uhle	4	3—5	30· 4	26·1	216· 0	123· 0
Mosler ...	1	6	34· 1	42·6	254· 6	101· 6
Scherer ...	1	7	49· 3	37·2	282· 4	...
Mosler ...	1	11	52· 8	61·3	328· 9	163· 6
Uhle ...	1	13	72· 0	26·6	290· 4	...
Bischoff ...	1	16	107·58	26·1	304·64	135·87

GIRLS FROM 3 TO 5.

Observers.	No.	Age.	Weight.	Urine.	Urea.	Na. Cl.
			lbs.	ounces.	grains.	
Scherer Rummel Uhle	1 1 1	3 to 5	33	24·9	226·18	106·5

GIRLS FROM 15 TO 20.

Observers.	No.	Age.	Weight.	Urine.	Urea.	Na. Cl.
			lbs.	ounces.	grains.	
Mosler ...	1	16	72·6	56·5	355·12	115·8
Mosler ...	1	17	101·2	53·9	378·28	148·224
Rummel Uhle ...	1 1	17 18	131·2	29·4	349·37	125·0

The quantities of urine and ingredients discharged by individuals of the same age of both sexes below ten years of age are equal.

Children of both sexes, under seven years of age, excrete almost double the amount of urea which an equal weight of adults excretes.

TABLE XV.

ESTIMATE IN ROUND NUMBERS OF FLUID VOIDINGS AND VALUABLE INGREDIENTS IN ADULT MALES AND FEMALES.

In 24 Hours.	Males.	Females.
	Avoirdupois.	Avoirdupois.
Water (Urine)	52 oz.	42 oz.
Urea	500 grains.	400 grains.
Uric acid	8·5 ,,	7·3 ,,
Creatinine	12 ,,	10 ,,
Hippuric acid	19 ,,	15 ,,
Phosphoric acid	50 ,,	55 ,,
Sulphuric acid	32 ,,	30 ,,
Chloride of Sodium	210 ,,	170 ,,
Ammonia	10 ,,	8 ,,
Potash	58 ,,	48 ,,
Magnesia	3 ,,	2 ,,
Lime	3·5 ,,	3 ,,

TABLE XVI.

ESTIMATE IN ROUND NUMBERS OF FLUID VOIDINGS AND VALUABLE INGREDIENTS OF MALES AND FEMALES, BELOW 20 YEARS OF AGE.

	Males and Females.
AGE 3 TO 5. Weight, 30 lbs.	
Water	25 oz.
Urea	200 grains.
Other organic and mineral solids	225 ,,
AGE 5 TO 10. Weight, 41·7 lbs.	
Water	40 oz.
Urea	270 grains.
Other organic and mineral solids	300 ,,
AGE 10 TO 15. Weight, 62·4 lbs.	Males.
Water	44 oz.
Urea	310 grains.
Chloride of Sodium	160 ,,

AGE 15 TO 20. Weight, 103 lbs.	Males.	Females.
Water	26 oz.*	46 oz.
Urea	305 grains	360 grains.
Chloride of Sodium	136 ,,	130 ,,

* One observation only.

SECOND SERIES.—XVII. TO XXI.

SHOWING THE AGES OF THE PEOPLE IN LONDON, AND THE NUMBER OF ADULTS TO WHICH THEY CORRESPOND PHYSIOLOGICALLY; ALSO THE AMOUNT AND VALUE OF THEIR URINARY VOIDINGS.

TABLE XVII.

AGES OF THE PEOPLE IN LONDON.

Ages of Males and Females enumerated April 8th, 1861.

ALL AGES.		YEARS.				
Both Sexes.	Males and Females.	Under 5	5.	10.	15.	20.
2,803,989	Males. 1,307,781	180,893	149,335	130,799	119,949	122,548
	Fem... 1,496,208	181,403	150,924	133,550	139,206	154,841

	YEARS.							
	25.	30.	35.	40.	45.	50.	55.	60.
Males ...	111,668	102,755	88,366	82,068	62,782	51,497	34,985	30,438
Females	140,367	122,012	102,151	93,832	71,408	61,231	43,202	40,878

	YEARS.							
	65.	70.	75.	80.	85.	90.	95.	100 and upward
Males ...	17,614	12,241	6,133	2,706	779	183	38	4
Females	25,322	18,862	10,061	4,821	1,615	412	93	17

NUMBER OF CHILDREN IN LONDON AT EACH YEAR UNDER FIVE.

SEX.	YEARS.				
	Under 1.	1.	2.	3.	4.
Males	42,262	35,588	35,602	34,344	33,097
Females	42,229	35,704	36,092	34,379	32,999

TABLE XVIII.

THE POPULATION OF LONDON CALCULATED AS ADULT MALES.

Total souls ... 2,803,989.
Males above 20 and below 60 ... 656,669.
Females ditto ... 790,044.
The fluid voiding of one female between 20 and 60, to the ditto of one male ditto is as 4 to 5. $\frac{790,044}{5} \times 4 =$ males 632,035.

The fluid voidings of 790,044 females are equal to the fluid voidings of 632,035 males.

Of the 84,491 children under 1 year, about one quarter will contribute about 8 oz. of urine per day. The rest will be lost. The amount collected will scarcely make up for the loss incurred through children 1 year and under 2 years of age. This class comprises 71,292 souls. Deducting probable losses, 5 children may be estimated to furnish the value of 1 adult male.

$$\frac{71,292}{5} = \text{adult males } 14,258.$$

The children 2 years and under 3 number 71,694, and may be computed to furnish value in the proportion of fluid to an adult male $\frac{71,694}{4} =$ adult males 17,923.

Of children 3 years and under 5 years of age, 134,819 are living in London. Their fluid voidings may be computed to equal those of half their number, or 67,409 adult females, and thus represent the value of

$$\frac{67,409}{5} \times 4 = \text{adult males } 53,924.$$

Of individuals of both sexes from 5 years upwards and under 10 years of age, there are living in London 300,259. Every 2 of these excrete valuable matter equal to 1 adult male. This represents a contingent of adult males, 150,129.

Of individuals of both sexes aged 10 years and under 15, there are 264,849 living in London. The excretions of every 5 of these may be estimated as equal to that of 3 adult males. This amounts to the produce of adult males, 158,607.

During the years from 15 to 20 the amount of valuable matter voided becomes larger, to the amount probably of one-seventh, in females than in males. Taking the average discharge of valuable matter in an individual in this category to be seven-tenths of that of an adult, then the 259,155 living in London excrete as much as

$$\frac{259,155}{10} \times 7 = \text{adult males } 181,405.$$

Between the age of 60 to 70 the quantity of valuable excreta falls ten per cent. below those of middle-aged persons. Of the 48,052 males of that age living in London, 4,805 will have to be deducted, leaving adult males 43,247

Of females of the same age (60 to 70) there are living in London 66,200. From these, for the same reason, 10 per cent. have to be deducted, leaving 59,580 middle-aged females to be placed into the account, which represent value of $\frac{59,580}{5} \times 4 =$ adult males 47,664.

It may be assumed that in persons between the ages of 70 and 80 the quantity of valuable matter excreted in the urinary fluids falls 20 per cent. below that of middle-aged adults. The 18,374 males of these ages living in London represent, therefore, middle aged males, 14,700.

The 28,923 females of between 70 and 80 represent 23,139 females of middle age, which

$$\frac{23,139}{5} \times 4 = \text{male adults } 18,508.$$

It may further be assumed that in people of from 80 to 100 years of age the quantity of valuable matter excreted in the urine falls 30 per cent. below that of middle age. Of males between 80 and 100, and upwards, there are living in London 3,710, which (minus 1,113) leaves middle-aged adults 2,597. The 6,958 females between 80 and 100 and upwards represent (minus 30 per cent., 2,085) 4,873 middle-aged females. These in their turn represent $\frac{4,873}{5} \times 4$ middle-aged males, $= 3,896$.

SUMMARY.

1 year	and under	2	equal to adult males	.....	14,258
2 years	,,	3	,, ,,	.....	17,923
3 ,,	,,	5	,, ,,	.....	53,924
5 ,,	,,	10	,, ,,	.....	150,129
10 ,,	,,	15	,, ,,	.....	158,607
15 ,,	,,	20	,, ,,	.....	181,405
20 ,,	,,	60	males ,,	.....	656,669
20 ,,	,,	60	females equal to males	...	632,035
60 ,,	,,	70	males equal to middle-aged		43,247
60 ,,	,,	70	females equal to males	...	47,669
70 ,,	,,	80	males ,, ,,	...	14,700
70 ,,	,,	80	females ,, ,,	...	18,508
80 ,,	,,	100	males ,, ,,	...	2,597
80 ,,	,,	100	females ,, ,,	...	3,896
					1,995,567

Taking into account that there are many thousand persons who come to London during the day, but sleep without (and are not enumerated as living within) the metropolitan districts, and deposit their fluid excretion in town, also many thousands of casual visitors; taking further into account the rapid increase of London, we are justified, I think, in assuming that the population of London excretes an amount of urine and valuable ingredients equal to that of 2,000,000 adult or middle-aged males.

TABLE XIX.

AMOUNT AND VALUE OF THE FLUID VOIDINGS OF THE POPULATION OF LONDON, CALCULATED AS 2,000,000 ADULT MALES.

Per day.

Urine, 650,000 gallons, or 2,901 tons 176 gallons.

Ammonia from urea, 36 tons (36·08), at £60 per ton, value £2,160.

Ammonia, from its salts ..... } 2·9 tons, value £174.
,, ,, uric acid ..... }
,, ,, creatinine ..... }
,, ,, other nitrogenous matters ..... }

Phosphoric acid, 6·2 tons, £86 16s.

Sulphuric acid, 4 tons, value £37 6s.

Chloride of sodium, 26 tons, value £122 16s.

Potash, 7·3 tons, value £233 12s.

Lime and magnesia, 1,714lbs., value 17s. 10d.

Total urine, 2,901 tons 176 gallons; and in this:—

Total solids, 84 tons, or 1 ton of solids in 34·5 tons of urine.

Total value, £2,832.

TABLE XX.

AMOUNT AND VALUE OF THE FLUID VOIDINGS OF THE POPULATION OF LONDON, CALCULATED AS 2,000,000 ADULT MALES.

Per annum.

Urine, 237,250,000 gallons, or 1,059,151 tons, 176 gals.

Ammonia from urea, 13,140 tons, at £60 per ton, value £788,400.

Ammonia from its salts, 465·5 tons, value £27,930.

,, ,, uric acid, 160·8 tons, value £9,648.

,, ,, creatinine, 251·8 tons, value £15,108.

,, ,, other nitrogenous matters, 200 tons, value £12,000.

Phosphoric acid, 2,271·8 tons, value, at 1½d. per lb., or £14 per ton—£31,805 4s.

Sulphuric acid, 1,489·5 tons, value at 1d. per lb., or £9 6s. 8d. per ton—£13,614 10s.

Chloride of sodium, 9,776 tons, at ½d. per lb., or 92s. per ton—£44,972.

Potash, 2,709·4 tons, value, at £32 per ton, £86,700.

Lime and magnesia, 625,610 lbs. (270 tons), at 1s. 8d. per lb., £325 16s. 8d.

Total urine, 1,052,151 tons, and in this:—

Total solids, 30,735·4 tons uncombined, being 1 in 34, or 3 per cent.

Value of each ton of solids, £34.

TABLE XXI.

ANNUAL VALUE OF THE FLUID VOIDINGS OF THE POPULATION OF LONDON.

SUMMARY:—

Ammonia ...	from urea	£788,400
	,, ammoniacal salts	27,930
	,, uric acid	9,648
	,, creatinine	15,108
	,, other nitrogenised matters	12,000
Phosphoric acid	... ...	31,805
Sulphuric acid	... ...	13,614
Chloride of sodium	... ...	44,972
Potash	... ...	86,700
Lime } Magnesia }	... ...	325
Total	... ...	£1,028,802

Value of 1 ton of urine rather less than £1.

Value of annual urine of one adult male, rather more than 10s.

The second Paper read was—

ON A SYSTEM OF EARTH SEWAGE.

BY THE REV. H. MOULE.

In a paper on the "Utilization of Town Sewage, which is contained in Vol. xxiv., Part 1, of the *Journal of the Royal Agricultural Society*, Mr. Lawes has written thus:—"No one will doubt that if the sanitary requirements of the nation could be attained by any system which would preserve the excrements of the population free from admixture with water, and present them for use at once undiminished in value by decomposition, and in a portable and innoxious condition, the land of the country devoted to the growth of human food might, by their application to it, be greatly increased in its productiveness. The question of the sanitary arrangements of our towns was taken up by our engineers before agricultural chemistry was much studied; and they have committed us to plans which, though they effectually remove the noxious matters from our dwellings, must greatly limit the area and mode of their agricultural utilization, and which, at the same time, have tended to the pollution of our streams. To say nothing of the enormous cost that would be involved in entirely subverting the present methods of removing the excrements of the inhabitants of our large cities from their dwellings, it must be admitted that no feasible scheme has yet been proposed by which this could be accomplished without the use of water. Such is certainly a great desideratum, but, perhaps, a consummation more to be wished than expected."

By thus placing this extract from Mr. Lawes's paper at the head of that which I am about to read, I would not lead to the expectation of any attempt on my part to prove that, for the removal of the excrements of the inhabitants of our large towns from their dwellings the scheme I propose is perfectly feasible. Such a proof, indeed, I am quite prepared to give; but so great is the array of prejudice, of self-interest, and, shall I say, of ignorance, against it, that, though I should establish my scheme beyond all contradiction, my proof would not, for any practical purpose with reference to our great cities, have, at the present time, the weight of a feather. It will probably require another half-century of experience to convince the public that the present drainage system, while relieving particular premises and special localities, is at the best but a shifting of an evil, increasing in its noxious character as it goes along from one spot to another, and that even the boasted and extravagant drainage of this metropolis is only a palliation and a temporary relief. The day will come, when, from the increase of the population higher up the river, an equal amount of pollution to that which is now to be withdrawn from it will be poured into the Thames; and

when, from the increase of filth, sand and rubbish poured into them, the main sewers, calculated for the present evil, will then be ineffectual for their purpose. There is only one observation which I would make on my scheme with reference to its application to large cities in which the water drainage now exists. Mr. Lawes says that the subversion of the present system in favour of any other would be attended with enormous expense. Now, in the establishment of the earth sewage system no public works are required, whilst the three-and-a-half millions being spent by the Metropolitan Board for the greater efficiency of the public works now existing, would have defrayed double the cost of all private works of the earth sewage system for London; and the manure saved instead of wasted would, on the very lowest estimate, have produced a clear income of £50,000 a year. But enough of this; I will proceed to state—

I. The principles of what I have ventured to call the system of earth sewage.

II. The mode of their application in closets, or commodes and urinals.

III. The provision of earth for single dwelling houses, or for large establishments, and for our smaller towns.

I. The peculiar adaptation of various kinds of earth for the complete and economical removal of excrementitious matter consists not in the mere fact that such earths are good deodorisers. This has long been observed and known. But it was not known until a very recent period that under certain circumstances the quantity of earth required for this purpose is very small. When the contents of a vault or cesspool have been allowed to ferment and generate offensive gases for months and years, it has been found that the proportion of earth required to destroy its offensiveness is immense. If, however, the evil be taken in detail, and the remedy applied at once, the reduction in the quantity required is incredible until tried. Three half pints of earth dried in the atmosphere and passed through a sieve with a mesh of one-eighth or one quarter of an inch, is amply sufficient for each use of an earth closet. It at once stops emission of offensive smell; it prevents fermentation; and these results are so complete and lasting, that either the same day, or after a week, or even a longer period, the mass of soil and earth can be removed from the room and the premises without any offence. If when thus removed a coarse sieve be used, the earth which passes through the sieve will in a day or two be dry enough to be used again, while all that which will not pass through, being thoroughly mixed together by a spade, or in any other way, forms a highly concentrated and inoffensive manure. Or if on removal the whole mass be thus mixed together and left to dry, it may with equal absorbing and deodorising efficacy be employed in the closet again. And so remarkable is this capability of earth for the absorption of such substances and gases, that I have myself subjected it to this repeated action ten times.

Here, then, in the case of a single closet is exactly that which Mr. Lawes requires. Indeed, if comfort and sanitary considerations be taken into the account, there is more than he requires; for together with the entire suppression of fermentation and of the escapes of noxious and offensive gases, there is here "the preservation of the excreta free from admixture with water; and they are presented at once undiminished in value by decomposition, and in a portable and innoxious condition."

II. As to the mode of application of earth in closets and commodes, it is obvious that it can in many cases be done without the use of machinery; and thus, in fact, it has been applied in not a few cottages, and amongst other public institutions, in the workhouse school of 55 children, at Bradford-on-Avon. A box of dry earth, with a scoop, is placed in the privy, and the children are required to throw in a scoopful on each occasion of its use. This has been attended with such complete success, that the Vice-Chairman of the Board of Guardians of the Bradford Union states, that where all before was "noxious pungency" there is now no offensive smell. And as to the quantity of earth used, he states, that from the repeated use of the same earth, the whole mass at the end of five months amounted to no more than 1½ ton, but that a mass of valuable manure.

It soon became clear, however, that in such cases self-action would be advisable, and in some cases almost a matter of necessity, whilst an application of the earth by machinery would be far more convenient, and might be more immediate than by hand. Accordingly, a very simple contrivance was tried for a time, which, however, soon in its use betrayed two or three defects, In consequence of these defects, Mr. James White, of Dorchester, applied his mind with much ingenuity and patience to a subject attended with far more and greater difficulties than any one who has not gone into it can conceive, and has produced in the patent earth closet of his manufacture that which, while almost equally simple with the former plan, obviates all its defects, and is, in my estimation, perfect. In its simplest form it may be thus described. At the back of the commode or closet is a box or reservoir filled with dry earth, at the lower part of which is a revolving hopper with four compartments, tach of which is capable of containing the required quantity of earth. By a very simple piece of machinery the weight of the body in sitting down turns this hopper and fills the compartment with earth. On the person rising from the seat, the hopper revolves one quarter of its circumference, and throws the earth by means of a shoot directly on to the soil and under the pan. The same operation can, of course, be performed by the use of a lifting handle, and in this case the application can be instantaneous, an advantage which, in sick rooms and in hospital wards, appears to me to be incalculable. The excreta and earth together can of course be received in the case of a commode, in a bucket, or from a fixed closet passed through a pipe or shaft into a receptacle below, from whence its removal would be the most practicable. There is another form of closet, consisting of a set of knives in the form of a screw, which mixes the mass and at the same time cuts the paper to pieces, and forces the whole out in a perfectly inoffensive form. But the description of this I leave to the manufacturer. As to the use of earth in urinals no machinery is necessary, and its efficacy is complete. A truck or pit, eighteen inches or two feet deep, and filled with dry earth, occupies the space both under the standing place and three or four feet in front of this. The standing is formed of an iron grating, the continuation of the iron railing which forms the barrier. All offensiveness is thus prevented and a valuable manure produced. Public urinals on this plan in the metropolis, and in large towns, and at our railway stations, instead of the nuisances such urinals now are, might be completely inoffensive and innoxious, and might be made to pay. One ton of earth or of London clay would be sufficient for 1,000 uses, and dried at a temperature under boiling heat, might be used for the same purpose and with increase of value again and again.

III. In speaking of the supply of earth for closets, &c., I will take first the case of a detached house with a garden. All that I, in such a case, have to do is to take a few barrow loads of earth from my garden and allow it to lie for a time to dry. When used sufficiently in the closets, instead of being a loss to the garden, it is returned, as money borrowed, with interest. It has become a manure, highly concentrated, and so easy of application that a handful or two may be equal to a barrow-load of ordinary manure. This I have proved by many experiments. If from this we rise to a large establishment, say a barrack with two troops of cavalry, the same farmer who supplies straw for the horses, as soon as he sees the value of the human excrement, and can have the opportunity of removing it, will supply earth for closets. He will not grudge the earth from his fields, which is to be returned to him after a time equal in value, as it may be made, to superphosphate, or crushed bones, or guano. But if his

soil be light and thin, and he have clay in the neighbourhood, then he can easily and cheaply procure that substance, and if he mix it with such ashes as he can get, or with street sweepings, he obtains by the admixture a most valuable manure, exactly suited to his land. Or if, in the last place, we take the case of a town which, either is in such a position that it cannot be drained, or, the inhabitants of which, being unwilling to enter on the expensive, and now doubtful, system of water drainage, should be disposed to adopt the earth system, a company could provide, according to the circumstances of the neighbourhood, clay, peat, earth, silicate of alumina, or any other earth or sub-soil, except chalk or limestone, and adding to it, if they please, soot, or any other fertilising materials, they might send it with as much ease as they send artificial manure, to those parts of the country which manure prepared from any of those earths and substances would best suit. For instance, the manure of London, instead of being either wasted in the sea, or, not much better, wasted on a few thousand acres in the marshes of Essex, if mixed with the clay which is everywhere at hand, and with the soot and some ashes and street sweepings, might convert the sandy heaths to the west and south-west into fruitful pastures and cornfields. There would, in the one case, moreover, be no transfer as there is in the other, of the locality of malaria and offensive smell from the town to the country. And, whilst the whole neighbourhood of the Essex marshes will abominate the daily influx into those marshes of a lake of filthy slush, the most offensive part of that slush, freed from the water, and converted by the earth into an inodorous and valuable fertiliser, would, by the owners and occupiers of the heaths of Surrey, Hants, and Dorset, be not only welcomed but readily purchased.

DISCUSSION.

Mr. Alderman MECHI thought they must all agree that they were indebted to these two gentlemen for the valuable information contained in their papers, and they might safely congratulate themselves upon the progress that had taken place with respect to this question. Twenty years ago a man would have been considered almost foolhardy who would have ventured into such details on a question of this kind before this Society, but happily the spread of intelligence, and the necessity for producing food more abundantly and cheaply, had caused them to devote their attention more closely to this matter. If he rightly understood the question, Mr. Moule's principle was to bring the earth to the excrement, whereas Dr. Thudichum's was to carry the excrement to the earth; but both agreed that it was essential, for the fertilisation of the soil, that the earth and the excrement should be mixed together. He believed that it might be as much as half a century before the value of these suggestions was fully recognised, though no doubt, now that it was admitted that human excrement had a money value, it would in some way or other be made a source of profit. He was glad to hear from Dr. Thudichum a confirmation of the opinion he (Mr. Mechi) had expressed with regard to the annual value of the excreta of each individual. He was examined before the committee of the House of Commons last year on this subject, and he then expressed an opinion that the excrement of each individual in the metropolis with the other sewage matters, might be valued at about 16s. per head, but he was confronted by other evidence putting the value at only 2s. per head, whilst Dr. Thudichum had shown this evening that the urine alone of each individual was worth 10s. per head per annum, and the other portion would, of course, have a minor, but still a considerable value. As, however, it might be half a century before any such views as those advocated by those two gentlemen were generally adopted, they had in the meantime to deal with the question as it now stood. The Metropolitan Board of Works had nearly expended their £4,000,000, and had made those great channels for conveying to the Thames the excrement of three millions of people. He felt that such an intolerable nuisance and waste could not be long permitted, and it was with that question they had immediately to deal. He hoped the legislature would appoint another Committee to take evidence upon the utilisation and adaptation of that sewage, for there were still many points upon which we were still without reliable information. This was a most important ratepayers' question, for it was clear that the Metropolitan Board of Works were not at present in a position to dispose of that sewage, as the facts upon which an estimate of its value could be made were not sufficiently before them, and he had been told by one of the members of that Board, that hitherto the only offer made for the sewage, which had been estimated to be worth two millions a year, was £5 from one individual and nothing from another. Since then other tenders had been requested, and he believed some sealed tenders had been sent in, the opening of which were deferred for some two months. Any company that proposed to deal with that immense mass of matter must have very large means, inasmuch as if the mere conducting of this sewage to the Thames cost between three and four millions, the reconducting it to the land which required it would involve an expenditure which they could not deal lightly with. He said this much, because he believed the question was forcing itself largely upon the public mind. They knew that to feed the population of London alone required the produce of six or seven millions of acres annually, and when they considered that the consumption of food from that large area tended to the exhaustion of the land, and necessitated large returns of manure if its fertility was to be maintained, it was obvious that they must direct their attention to the economising of a material of so much value, and the prevention of such an enormous national waste.

Mr. VARLEY congratulated the Society on having brought forward this subject, because it was a great step towards returning to the original laws of health and cleanliness which were laid down by Moses for the ancient Jews. No other nation had such a code of sanitary laws as the Jews, and these we had entirely neglected. It seemed a most preposterous thing that we should send to the other side of the globe to bring away the accumulated deposits of birds whilst we had such an abundance of fertilising matter at home.

Mr. LIDDLE (Medical Officer of Health for Whitechapel) said there could be no doubt, from the experiments which Mr. Mechi had made, that there was considerable value in the sewage of London. In regard, however, to making alterations in the present mode of carrying away the excrement of such a large population as that of the metropolis, he was afraid it would be attended with great difficulties, owing to the class of persons they were brought into contact with, who had no idea of adopting those means which the Jews of old did, as recommended by their great lawgiver. In the first place, in London there would be difficulty in procuring the earth to be employed in the way indicated by Mr. Moule. They had no room to make use of such means, the houses were placed so close together, many of them not having even a back yard; therefore they were obliged to adopt the present system, namely, the conveying away the matter by the aid of water. He had known the district of which he had now the sanitary superintendence, for forty years, and he must say the improvement had been very great during that period, the system of drainage having been most materially improved. He was aware that they lost a large amount of material, proper to be applied to the land and capable of producing food. They now received large quantities of wheat from abroad, which, by the proper cultivation of the land, and the consequent increased employment of the population, it would be very desirable to produce at home. At the same time, there were many difficulties in the way. He considered the views put forward by Dr. Thudichum were impracticable in the present day, more especially the proposition of having two receptacles—one for excrement and one for urine, although it was true that in fifty years they

might alter their opinions and habits very much. There was another point which had not been adverted to. There were in London other matters which had to be dealt with, such as the refuse from slaughter-houses and cow-houses, which formed valuable manure. They had not been told in either of the papers how it was suggested to deal with these.

Mr. FREEMAN said the value of human excreta being, he apprehended, admitted on all hands, the point they had to discuss was, whether they could practically avail themselves of the two plans which had been suggested for the disposition of them. With regard to the plan proposed in Dr. Thudichum's paper, he thought the chief objection to it consisted in its extreme complication. It was, in fact, returning to Mr. Ward's old plan of having duplicate drains for every house; and he ventured to think, with regard to the system proposed in this paper, if it were laid before the public of the metropolis, it would be universally decided that the nuisance in every house would be so great, and the whole thing so complicated, that they would much rather sacrifice the pecuniary consideration than be encumbered with it. The sanitary consideration—which was the great object in view—appeared to be lost sight of in these propositions, more particularly as it concerned the metropolis. Would not the plan now advocated endanger the sanitary state of London? Would it not fill the houses with gases and odours that were anything but health-promoting? It appeared to him so complicated, and so likely to give rise to danger and difficulty, that he was inclined to think it was not what was required. The plan of Mr. Moule was certainly the more simple; but the great difficulty would be to get the poorer classes to understand it. Every time they used this apparatus they must be careful to take a sufficient quantity of earth to cover over the fæces; they must also have the earth dried and properly prepared for the purpose. It had been mentioned that clay could be used; but it would have first to be reduced to powder. He agreed with Mr. Liddle that all these various processes would take an immense amount of time and trouble, which, in his opinion, rendered the scheme impracticable. The Metropolitan Board were excessively anxious to solve the question of the disposal of the refuse matters of London. They had evidence as to the commercial value of the material, and public tenders for it had been invited. All the talent of our scientific men had been appealed to for some practical plan whereby this matter might be utilised. It had always been considered of value. His own idea was that the opinion of its value was going down rather than increasing. He recollected the time when it was said it would return an actual income of one million if it were properly utilised, but he was sure that high estimate was not put upon it in the present day. The great difficulty was to prevent its becoming so diluted with other matters as to render it valueless, and to maintain it in a sufficiently condensed state. These plans he thought were so complicated, requiring so much scientific knowledge, and so much time, that they could not be generally adopted, and if adopted, he believed they would not turn out well.

Dr. GIBBON (Medical Officer of Health, Holborn District), expressed his concurrence in the views of the last speaker upon the impracticability of the proposed plans in large towns. The Metropolitan Board had fairly met and disposed of the sanitary question, and the health of London had been improved immensely as compared with what was the case under the old system of cesspools, which was still maintained in Paris. The mortality of London was considerably below that of Paris at the present day, and considerably lower than it was 50 years ago; at the same time, he admitted that the value of the excrement wasted was very great. He should very much like to see this system carried out in the country districts, where the proper supply of dried earth could be readily obtained, and where ready means of disposing of the matter to the farmers of the locality existed. He thought the difficulties of introducing the system amongst town populations were insuperable. With regard to Dr. Thudichum's plan, he was sceptical as to what would be the results of this complicated system of pipes. He feared there would be constant obstructions in these uroducts, and the urine would become decomposed in the tanks, unless the atmospheric air was hermetically excluded. The coproduct he imagined would be an excessive nuisance, notwithstanding the lime and the earth, although he agreed that earth was the best disinfectant and the best absorbent when perfectly dry.

Mr. CLARKSON concurred in the opinion expressed that the great objection to the plan proposed was its complexity. Anything beyond the most simple appliances would be attended with practical difficulty. Mr. Clarkson mentioned instances in which he had successfully disposed of large masses of excreta from establishments in this country, and also in Paris.

Mr. PLUM remarked that the only question on which there was any difference of opinion was the practicability of adopting either of the two proposals submitted. One objection he looked upon as insuperable, that was, they had proceeded too far on a bad and unsound principle, and they did not like to retrace their steps. There was no question in his own mind that either of those proposals might be carried into practical operation. He believed the ingenuity of men quite sufficient to provide for all the practical difficulties which stood in the way, just as the practical objections to the main drainage of the metropolis had been overcome by engineering science. He could confirm the experience of the gentleman who had spoken with reference to the necessity of dealing with the sewage matter in detail, and he (Mr. Plum) contended before the Commissioners of Sewers, fifteen years ago, that the great error was in the wholesale mode of dealing with the sewage. If they dealt with it in detail, in small quantities, it would be well, but they could not deal with it on the enormous scale which was now attempted, looking at the large admixture of foreign matters which rendered the sewage of London almost valueless. In some cottages he had built in the country he had introduced an arrangement for covering the excreta with the coal ashes made in the houses, and he found by that means a valuable solid compost was produced, which was readily disposed of to the farmers, and he had no doubt in agricultural populations the plan proposed by Mr. Moule could be adopted with great advantage, notwithstanding it was probable that a large amount of prejudice would have, in the first instance, to be encountered. But he hoped for better times, and that they would yet see the day when the signal failure for which we were now paying so dearly, would be remedied.

Mr. B. H. PAUL said the propositions contained in the papers read might be considered as a confession of error on the part of those who insisted upon the utilisation of sewage, under the existing system of water carriage. The proposed return to a method of disposing of excretal refuse, without the use of water, was not very likely to find favour in a sanitary point of view, when compared with the advantages which, in this respect, the water carriage system undeniably possessed, so far at least as the condition of dwellings was concerned. But the object with which the dry system of sewage was proposed, was less of a sanitary than of an agricultural nature, and, like the suggested application of sewage to agriculture, had originated almost entirely from views put forward by Baron Liebig with regard to the conditions determining the fertility of land. It had been argued that materials indispensably necessary for the growth of corn were abstracted from the soil, and that, as corn was consumed as food, they eventually passed into animal excrements. Hence, it was urged that these waste materials had an agricultural value, that the present mode of disposing of them was a waste and a serious loss, and that the result to which it would lead was the exhaustion of land to a condition of entire sterility. Whatever truth there might be in these views, it was not the less certain that to induce people, for these reasons, to

acquiesce in a change from the water carriage system to the dry sewage system, involving so much questionable excremental manipulation, the arguments in favour of the views just mentioned must be very strong, and, even if it could be shown that they were correct, it still remained a question whether the removal of excremental substances, with a view to their use as manure, could be best effected with or without water. The arguments that had been brought forward in support of those views were various; among others, the customs of the Chinese and the Japanese had been dwelt much upon, but it would seem that those customs owed their origin more to sanitary than to agricultural considerations. The apprehensions that had been expressed as to the possible future exhaustion of soils, in consequence of the present mode of disposing of excreted substances, appeared to have been much exaggerated, and it was a question whether they did not originate from a too limited view of the matter. Apprehensions of a similar kind had been at various times put forward. Thus, for instance, about two centuries ago, it had been declared that there would soon be no fuel left to make iron with, in consequence of the exhaustion of the forests. Such an opinion seemed correct from the limited point of view whence the subject was considered, but from the more comprehensive view that might be taken of it, it seemed absurd. In all natural operations with which they had any intimate acquaintance, there was recognisable a principle of conservation; consumption and restoration compensated each other, and though, in some cases, the way in which this compensation took place was not recognised, there was not the less reason for regarding it as universal. Even in supplies of material productions, when one failed another was found to take its place, and to give rise to new and more important branches of industry than that which had been worked out. So in agriculture, we might with reason depend upon a continuance of such conditions as had already been found to afford a means of maintaining the fertility of the land.

The CHAIRMAN said it appeared to him that it was very important that the question, as had been remarked, should be as carefully looked into as possible, because the general question of sewage had been discussed so largely, and gone into so fully, that it would be beside the present purpose to go into it again, but they would do better to confine themselves definitely to the two proposals contained in the papers. With regard to that of Dr. Thudichum, it appeared that the separation of the liquid and solid did not solve the difficulty in so simple a manner as the plan described in the paper read by Mr. Moule. What appeared to be required was to deal in detail with the substance instead of committing it to the commixture of liquid from the rainfall, or the supply of water in the metropolis by the river companies and other sources, which placed it out of the reach, not only of the agricultural, but also of the commercial community, and likewise, to some extent, failed in a sanitary point of view, because, though water was to a great extent an absorbent, it did not retain the gases evolved from the sewage; and where the discharge was made into a tidal river, there was a liability of the sewage matters being brought back again in an offensive form. In dealing with excreta by means of earth, they did in fact return to the natural process. It was known that the power of clay as a deodoriser was much increased by subdivision, and a very small quantity produced the desired effect. Therefore, it ought to be considered as an important feature in Mr. Moule's plan, that the small quantity of earth required in a dry state presented less difficulty under many circumstances than the supply of water; and he apprehended the first proposer of the water-closet was exposed to all the objections that could be raised on the score of difficulty and complication. With respect to the supply of earth in the country there would be no difficulty, but the question was how the case could be met in the metropolis and large towns. It was not uncommon to refer to China and Belgium as instances of the use of liquid forms of manure; but the whole question was one of climate, and in the western parts of England the climate was so moist, as compared with the eastern, that the same principle that would succeed in the east would not succeed in the west. The rain-fall was also an important element in the question of the application of manure, whether in a liquid or in a solid form. With regard to the separation of the liquid and solid manure, it should be recollected that guano, which was the best manure, was voided in a mixed form. This manure of birds, where there was no separation, was the most valuable; and that appeared an additional recommendation of the system which placed both substances together. The whole subject, however, was one surrounded by difficulties, and they had good cause to be obliged to these gentlemen for the patience and scientific research they had bestowed upon a matter, always a difficult one, but which, as Mr. Mechi had said, would probably be less difficult to deal with as civilisation advanced. Not only was it important as a sanitary question, but also as a chemical and agricultural question. He trusted the subject would not end here. The proposals in their present form might not be practical or feasible, but every application of an ingenious mind to a subject of this kind was welcome and valuable. They might hope that in the future some means might be found by which the concentrated population of large towns might deal as well with this question as the more widely-spread population of the country districts, so that, eventually, the great law of nature might be satisfied, which made it apparent to every one that the fertilising of the earth ought to go hand-in-hand with sanitary considerations. The Chairman concluded by proposing a vote of thanks to the gentlemen who had contributed these interesting papers.

The vote of thanks having been passed,

Dr. THUDICHUM, in reply, said he had intentionally not entered upon the question of agriculture and exhaustion of the land, as all that could be said on that head was generally acknowledged, or capable of the easiest proof. The fertility of the land in ancient Judea, in China, and Japan, was maintained by the application, without the intervention of water, of human excretions to the soil. The Chinese had no notions upon this matter approaching the sanitary theories of Europe, but acted with common sense and with a view to profit. Regarding the allegation that his plan would produce nuisance, and interfere with the proper working of the sewers, he should certainly blush if such an imputation could be brought successfully against him, for he claimed to be a physician and a chemist. He would not have ventured to bring it forward did it not meet all considerations that could be urged, domestic cleanliness and comfort, public health, reduction of taxation, improvement of the means for carrying on the cultivation of the fields, purification of rivers, and improvement of drinking water, particularly that derived from rivers such as the Thames. The plan was, however, by no means devised for London only, but was applicable to the greatest variety of places. He was glad that gentlemen had promised that everybody would be of his opinion fifty years hence. The march of intellect and the necessities of agriculture would not, however, wait for those gentlemen, for guano, upon which they now depended, would be exhausted in thirty years, and what was England to do then? They would have to go to those sources which ever flow, and which can never be exhausted; they would have to collect human excreta somehow, whether by complicated means or by simple means. They would then obtain the best manure, which was not guano, but human urine, containing, as it did, all the ingredients of a manure necessary for the production of wheat and of meat. Guano was deficient in potash, and when brought upon land, also deficient in potash, would simply exhaust that land, as it had already done in numerous instances where farmers had abandoned the use of this manure. This exhaustion could never occur if human urine were applied. Indeed, if London

were to collect the whole of its urine, it could therewith manure a sufficient area of land to produce thereon the whole of the grain and meat which it consumed, and it could do so for every year, and for ever. He had another assurance that science would prevail before another fifty years of neglect had made the soil still poorer than it was. The chief magistrate of Stockholm had to deal with the sewage of that town, and had commissioned a chemist, Professor Müller, to investigate the subject. This gentleman had arrived at exactly the same conclusions as *himself*. He had published his report in March last, whereas he (Dr. Thudichum) had sent in his paper to this Society last autumn. The results of both were therefore arrived at quite independently of each other, which was a great guarantee for their value. In Stockholm, and the other northern towns, a closet with a divided pan, known under the name of Marino's closet, was no novelty. Professor Müller had stated that in each of those towns many thousand closets of that kind were in actual operation, and that their use was daily becoming more common. It was, then, to be hoped that Stockholm would set an example which London might follow, if other towns in England, such as Birmingham and Brighton, would not prefer themselves to set the example. In Belgium the use of human excretions was well understood. In Baden it was rapidly becoming appreciated. The Governor of Rastadt had caused the excreta of the garrison to be collected. In the first year it realised a profit which, in subsequent years, rose from a few hundred florins to 8,000, and last year to 8,000 florins, and would no doubt rise to three times that amount. This example should stimulate us to do something similar in our barracks, camps, hospitals, workhouses, and other public institutions, where great numbers of persons were kept at the expense of the community. It was a reproach that the camp at Aldershot, which might return a value of many thousand pounds per annum, should cost the country £1,200 per annum, fruitlessly spent for the removal of valuable matter. It had been stated that the Board of Works were most anxious to get the value out of the sewage of London that it was alleged to contain. But they wanted an exceedingly simple plan, and a member of the Board had termed his (Dr. Thudichum's) plan not sufficiently simple. This was a question of dealing with given laws of nature, and no preconceived demand for simplicity would ever solve it. The excretions had to be collected, to be made portable, and to be carried to the land, at the smallest cost. These demands he claimed to have satisfied better than any previous plan had ever done. Mr. Plum had truly said that there was no practical difficulty in the way of its being carried out, and the only impediment was in men's minds. Some speakers were possessed by a vague idea that the sewage of London could be distributed over a large area of land, and spoke as if no experiments had been made, and no inquiry carried on. He held in his hand the Report to Parliament on the Main Drainage of London, made in 1857. It contained evidence on the experiment which was made by a company in the Fulham-fields. The sewage of the south-western part of London was carried there in a sewer specially built, and distributed over the fields by means of pipe and hose. The company at first gave the sewage away, and it was used experimentally. But the gardeners and farmers found that it was of no use, and did not repay the cost of distribution, and would not have it even as a gift. The company lost £40,000, and when they took up their pipes they found them almost or entirely closed by an incrustation, caused by the deposition of the soap-and-lime compound contained in sewage. Now, if they distributed the sewage of London, and spent forty millions upon the attempt, they would lose their money as the Fulham Company had lost their forty thousand pounds. He appealed to the intelligence and goodwill of his audience and of the community to abandon chimerical ideas, and to consider and try the matter by the light of science. He was, from experience in other scientific contests, sufficiently aware that every new proposition did not usually meet with consideration, but contradiction, and that from those who acknowledged that they had no experience of their own on the subject. But he was satisfied to have stimulated inquiry, and he begged those present to give to the subject their most earnest consideration, and he had no doubt that some such plan as he had proposed would be carried out and the undertaking be crowned with success.

Rev. H. MOULE would only detain the meeting a few moments to say that many of the objections which had been raised against Dr. Thudichum's plan he took to apply equally to his own. He did not complain of the very fair criticism which had been passed upon these proposals. He thought people had a right to exercise their judgment upon a matter so novel; and no one who had not seen the simplicity of the operation of the closets he recommended would believe it. He had not brought before them a mere theory, but the actual result of five years' experience of the deodorising effects of earth upon fæces. He resided amongst a poor population, and he had been driven, as it were, to this discovery by the wretched provision of the cottages in his own neighbourhood. He had tried various contrivances to relieve the difficulty, until at last, as if by accident, he had lighted upon the present arrangements he had described. The repeated action of the same earth reduced the quantity necessary very considerably. Mr. Moule mentioned cases within his own knowledge in which his plan had been carried out on an extensive scale, and also the favourable results obtained upon crops by the application of the compost formed to land in his own neighbourhood. He added that he had throughout disclaimed having anything to do with London, or towns where there were water-works. But his field of operation was vastly wider than that. He contended that the Board of Health too much overlooked the country districts. The cottages were detached, but wholly undrained, and the rate of mortality was higher in some of the rural districts than in London. He knew one village in Dorsetshire where the rate of mortality during eight years had been 33¼ per thousand, as against 17 per thousand in London.

The Secretary announced that on Wednesday evening next, the 20th instant, a paper by Mr. B. H. Paul, "On Destructive Distillation, considered in reference to Modern Industrial Arts," would be read.

Home Correspondence.

THE SEWING MACHINE.

SIR,—May I be allowed to ask how it happens that this beautiful machine has from the first been only applied to the more complicated and ornamental departments of the business of the seamstress; and not to the simple operation of sewing two selvage edges together, which, when done by hand, is close and flat, in fact, not to be easily distinguished from other parts of the fabric.

I also beg to inquire why it is necessary for the machine to consume at least three times the quantity of thread ordinarily used in hand sewing, besides lost ends and other waste, and in addition making a clumsy thickness compared with handwork seaming.

I am further given to understand, that sewing machines cause a higher rate of charge to be made than is usual for sewing or seaming performed by hand.

Until these objectionable qualities be removed, it is impossible for this model of man's ingenuity ever to become a really useful domestic machine.

I am, &c.,

HENRY W. REVELEY.

Reading.

AUTO-TYPOGRAPHY.

SIR,—I really am not confounding glyphography and nature-printing, as Mr. Wallis supposes in his courteous rejoinder, printed in your number for the 24th April, to my brief remarks at the meeting.

Mr. Palmer, the inventor of glyphography, certainly practised the nature-printing process, and that long before its publication in Austria. He took lace, for example, hardened it by dipping in a solution, placed it between a thin plate of lead and a plate of steel, and, thus arranged, passed it through a strong copper-plate press. The result was a "nature-printed" impression on the lead, from which he made an electrotype reverse; in fact a *surface* block, printing at letter-press black lace on a white ground. From this reverse he produced a second electrotype plate, an intaglio, similar to the original lead impression, and this could be worked either at copper-plate or letter-press; from the former giving the effect of black lace on a white ground, and from the latter the effect of white lace on a dark ground—beautiful either way. Mr. Palmer applied the same process to the dried leaves of plants.

I am prepared to establish the correctness of my memory on these matters, by the evidence of assistants who worked the invention for Mr. Palmer, about 1840. My belief has never been that the gentlemen of the Austrian press were inventors of "nature-printing." I have rather supposed that, becoming acquainted with the inventions of men like Peter Kyhl and Palmer, they, very properly, used the government funds at their command to give publicity in their own country to the results of those processes. Without doubt they were acquainted with Palmer's other inventions, for in 1851 they exhibited specimens of glyphography, and, I think, of electrotint also.

It may not be amiss to recall attention to Palmer's "Electrotint," for which he took a patent in June, 1841. His object was to produce, from an artist's specially prepared painting, without the intervention of an engraver, an electrotype plate, which could be worked at the copper-plate press, and blocks, suitable to the letter-press. I cannot say much for the blocks, but with the plates he certainly succeeded to some extent, as witnessed by several very respectable half-guinea prints published at the time; among others, two fruit pieces by George Lance, favourably noticed in the *Times* of Jan. 15, 1842.

Palmer's plan differed from the ingenious invention of Mr. Wallis, in this particular, if in no other. He gently deposited electrotype copper upon the uneven surface of the painting till the copper became sufficiently thick to work from in the usual way; while Mr. Wallis forces the painting into the smooth face of a yielding metal. The former the work of days, the latter of a moment only.

Mr. Palmer's charge for a finished plate was 9d. per square-inch, and 1s. 6d. per square-inch for a surface block; but, notwithstanding its cheapness, the invention has passed out of use.

Sincerely wishing a better reward for the ingenuity and perseverance of Mr. Wallis,

I am, &c.,

WILLIAM DICKES.

5, Old Fish-street, Doctors' commons.

QUEEN'S COLLEGE.

SIR,—My attention has been called to the report of the proceedings of the Committee on Education in a recent number. In that report, Dr. Yeats, Mr. Watkins, and Mr. Whittington are represented as having drawn attention to the system of education and examination at Queen's College, London, and I cannot but feel grateful for the kind manner in which they have spoken of the work which the college has done in raising the standard of female education generally.

There is, however, an error of detail in the report which you will, perhaps, permit me to correct. Mr. Whittington stated, in his remarks, that any lady could be examined at Queen's College on payment of a fee of five shillings. The actual scale of payment is one guinea for the first examination, and half a guinea for each subsequent one.

I send by book-post a printed syllabus showing the extent and character of our examinations, and a prospectus of our college course, and shall be happy to forward copies of both or either to any of your readers who may wish to know more about us.

I am, &c., E. H. PLUMPTRE.

Queen's College, 67 and 68, Harley-street, W.
April 29th, 1863.

COMMITTEE ON MANUFACTURES.

SIR,—I beg to draw your attention to an inaccuracy in the report of this day's *Journal*, of the suggestion I made at the invitation of the Chairman of the Committee on Manufactures, held on the 1st instant, in reference to the working in the precious metals.

The suggestion I made was, that it would greatly benefit the trade, and the public in general, if an Institution or arrangement could be made to collect together the many important facts resulting from experience, and communicating them to the rising workers in the trade, or others who wanted such information, so as to save the great loss of very valuable material and much time, resulting from a knowledge of first principles and experience.

It never occurred to me to invent a machine to extort valuable trade secrets of any sort, but as free trade is now an acknowledged advantageous principle in commerce, I cannot see why it should not be of equal value in thought; and in my own case I have always found it to be so, for, by freely communicating, from time to time, the knowledge gained by my own experience, to those persons who desired such information, I have always found others ready to communicate to me the result of their experience, thereby making a mutual advantageous exchange.

It was very late in the meeting that I was called upon for my suggestions, and being the only speaker upon the subject, I cannot understand who were the several members of the Committee who are reported gratuitously to have "expressed their opinion that there would be little chance of inducing manufacturers to divulge valuable trade secrets for the benefit of the community at large," which is to my mind a very vague expression. The report does not give the name of any of the several members so expressing their opinions, but presuming that their observations did not reach my ears, I would refer them to a work upon assaying gold and silver, by Mr. James H. Watherston, a member of the Society of Arts, in which he gave much valuable information to the community, and the whole of the profits accruing from the sale of that work to the funds of the Goldsmiths' Benevolent Institution, whereby he conferred a double benefit, without any view to his own individual interests.

With the object as above stated, apart from the counter-expressed opinions, as reported, I shall at all times be happy to join in any effort to advance the free intercommunication of knowledge acquired and experience gained, and from my knowledge of the workers in the precious metals I am convinced that we may expect much valuable assistance from the trade in general.

I am, &c.,

E. NASH.

30, Coppice-row, May 8, 1863.

Proceedings of Institutions.

SHEFFIELD LITERARY AND PHILOSOPHICAL SOCIETY.—The annual conversazione was held in the Cutler's hall, on Thursday evening, the 29th January, and went off very successfully. The committee entrusted with the arrangements consisted of Messrs. Sorby, Hambly, and Stuart, and through their exertions many objects of great interest were exhibited. Amongst them may be mentioned portions of the shot, holes, and armour-plate used

in the experiments at Shoeburyness; models of ships of war; a collection of photographic portraits of eminent men, contributed by several London photographers; Parian busts from the Art Union, lunar photographs lent by Messrs. Smith and Beck. In the fine art department Mr. Edwin Smith exhibited his machine for copying sculpture. The plan of its operation is as follows:—The bust or statue to be copied is placed on a revolving pedestal, and on a corresponding pedestal is placed a block of stone, roughly cut into a shape somewhat resembling the work to be copied. Over the copy and the block is suspended a lever, on one side of which is a blunt pointer, which touches the copy, and on the other a graving tool, which touches the block to be cut. As the machine works, the block is cut down until the pointer touches the copy, and as it follows the variations of the one the graving tool makes corresponding shapes on the other, until a faithful and perfect tracing is obtained. The machine was worked by a small model steam-engine, lent by Messrs. Chadburn Brothers. Specimens of Mr. Ransome's artificial stone, electric deposits, contributed by Messrs. Ratcliff and Co., through Mr. Edmund Heeley, were exhibited. Another application of electro-plating was exhibited by Mr. R. Drury—the electro-plating of lead with pure grain tin, his object being to do away with the sanitary objections to lead for water-pipes and cisterns. Messrs. Parkin and Bacon exhibited in operation a lithographic press, on which they were working fac-similes of the autographs of the presidents of the Literary and Philosophical Society from 1823 to 1863, which they presented to the visitors. Telegraphic science was represented by Messrs. Siemens, Halske, and Co.'s alphabetical telegraph, and by the printing telegraph of the same firm. Mr. Siemens also exhibited a model of his regenerative furnace, which has been used in the melting of glass. Messrs. J. B. Newhall and Co., of Sloane-street, London, exhibited an application of electricity to domestic purposes, in an arrangement of house bells which ring by the completion and breaking of an electric current. In the chemical department were shown specimens of a new invention, patented by Mr. A. Parkes, of Birmingham, and called after him, "Parkesine." It is a compound of oil, chloride of sulphur, and collodion, and is intended as a substitute for india-rubber and gutta-percha. Another substitute for india-rubber, invented by Mr. Frederick Walton (described in the *Journal*, vol. x., p. 324), to which he has given the name of "Campticon," was exhibited. The Sheffield School of Practical Science contributed a series of specimens of palm oil bearing upon manufactures, and also a series illustrating the manufacture of aluminium and aluminium bronze. An address was delivered by Dr. Elam, the President of the Society, in which he directed attention to some of the most remarkable objects exhibited.

TROWBRIDGE MECHANICS' INSTITUTION.—The adjourned annual meeting was held on Tuesday, January the 6th; T. CLARK, Esq., the President of the Institution, in the chair. Mr. Gauntlett read the report. The most important feature of the Institution is the lectures, of which 21 have been delivered during the year. The list shows a larger proportion of professional lecturers than in any previous year, many of them gentlemen of the highest reputation in their respective spheres. The members have never before received so large a return for their subscriptions. The committee expected to have effected a saving by making these engagements with lecturers, jointly with several neighbouring institutions, but in this their hopes have not been realised. The necessity of each institution sinking its own individual choice of lecturers, except to a very limited extent, is a great drawback and set-off to the advantage that occasionally occurs of paying a lower fee. The experiment was, however, worth a trial. The engagement of a larger proportion of professional men than usual has considerably increased the amount paid for lectures, and as there has been a decrease in the number of members, the subscriptions have not been sufficient to meet this increased expenditure. The classes have been well attended, and the several teachers report that their progress has been satisfactory. The thanks of the members are due to these gentlemen, who have given their gratuitous service in teaching. The short-hand class, owing to the small attendance, has been discontinued, and a drawing class commenced, for which the committee engaged a competent teacher, Mr. Millington, and they trust that a large number of members will avail themselves of the opportunity thus afforded them. The elocution and elementary singing classes are still continued. In the latter class the Tonic Sol-fa notation and system is used. The library continues to be much used. During the year about 1,290 bound volumes, 3,326 periodicals, and 361 newspapers, have been taken home by the members. The reading-room has been attended by a large number of readers, while the conversation and class-rooms have relieved it of the attendance of some who could scarcely be classed with the readers. The number of members is 306, the majority being of the mechanic or working classes. The reduction in the number as compared with the corresponding period of last year, caused by the depression of trade, and reduced earnings of the working classes, has contributed to render the financial position unsatisfactory, and leaves the institution in debt. The front room would continue to be used as a smoking and bagatelle room until March, when it would become part of the Institution suite; and this added convenience cannot fail largely to enhance the advantages of the Institution. Amongst the lecturers who are engaged for the remainder of the session, are Mr. George Dawson, of Birmingham; Dr. Letheby; Mr. Fairbairn, of London (for musical entertainment); Mr. Henry Nichols; Mrs. Balfour; and Mr. E. Wheeler (for his popular lecture on electricity). The Rev. William Barnes, author of the celebrated poems in the Dorset dialect, has promised a reading. Captain Gibney has also promised a lecture. Several gentlemen have promised their assistance in giving penny readings. The treasurer's cash account was then read by Mr. A. Gregory. The receipts were, from subscriptions, &c., £94 10s. 0½d.; from proceeds of lectures, £33 5s. 8d.; the late Mr. Brown's annuity, £5; from sale of old papers, £1 11s.; and a balance from the last account, £2 4s. 8d.—making a total of £136 11s. 4½d. The principal items in the expenditure were, for rent, £23 13s.; for lecturers' fees and expenses, £52 15s.; papers and periodicals, £12 13s. 11d.; printing, £5 16s. 6d.; gas, £3 12s. 6d.; attendance (librarian), £15 12s.; poles for gymnasium, £2 11s. 6d.; the cash balance in the treasurer's hands being £7 12s. 4½d; against which there were outstanding accounts amounting to £24 19s. 6½d., showing a deficiency of £17 7s. 2d.; or, if to this be added the amount £13 6s. 6d., subscribed for and to be spent in books, it will increase the deficiency to £30 13s. 8d. The election of officers then took place, and a vote of thanks to the chairman terminated the meeting.

MEETINGS FOR THE ENSUING WEEK.

MON. ...British Architects, 8.
Asiatic, 3. Annual Meeting.
Royal United Service Inst., 8½. Commander T. E. Symonds, "Steering and Manœuvring Ships with Broadside Batteries, by Means of Twin Screw Propellers."

TUES. ...Civil Engineers, 8. 1. Discussion upon Mr. Watson's paper, "On the Communication between London and Dublin." 2. Mr. J. Fernie, "On the Manufacture of Duplicate Machines and Engines."
Statistical, 8.
Pathological, 8.
Ethnological, 4. Annual Meeting."
Royal Inst., 3. Prof. Tyndall, "On Sound."
Architectural Museum, South Kensington, 7½. Mr. Wm. White, "On the Wrought Iron Work of the Great Exhibition of 1862."

WED. ...Society of Arts, 8. 1. Mr. B. H. Paul, "On Destructive Distillation, considered in reference to Modern Industrial Arts."
Geological, 8.
Pharmaceutical, 11 A.M. Annual Meeting.
THURS...Royal, 8½.
Antiquaries, 8½.
Chemical, 8. Mr. W. R. Grove, Q.C., "On certain Effects of Intense Heat on Fluids."
Numismatic, 7.
Philosophical Club, 6.
Royal Inst., 3. Prof. Ansted, "On Geology."
FRI. .....Royal Inst., 8. Prof. Roscoe, "On the Sun's Chemical Action."
R. United Service Inst., 3. Capt. Sir Sibbald Scott, Bart., "The History of the Bayonet."
SAT.....Royal Botanic, 3¾.
Royal Inst., 3. Professor Max Muller, "On the Science of Action."

To Correspondents.

ERRATUM.—In last number, page 432, col. 2, line 4 *et seq.* from bottom, for "Mr. Robinson had fully recognised the desire of the native community to avail themselves of the benefits of education," read, "Mr. Robinson had fully recognised the desire of the Europeans to afford to the native community the benefits of education."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Delivered on 24th March, 1863.

Par. Numb.
115. West India Colonies (Salaries of Colonial Offices)—Returns.
98. Poor Removal—Return.
72. Bill—Office of Secretary at War Abolition.
29. Railway and Canal, &c. Bills; (156. Albert Bridge; 157. Blackfriars Bridge; 158. Dengie (Essex) Reclamation; 159. Dundalk, Carlingford, and Greenore Railway; 160. Frieston Reclamation; 161. Fulham Bridge; 162. Horsey Island Reclamation; 631. Irish North Western Railway)—Board of Trade Report.
North America—Despatch from her Majesty's Minister at Washington (No. 4).

Delivered on 25th March, 1863.

60 (1.) Atlantic Royal Mail Steam Navigation Company—Further Return.
117. Tonnage—Return.
119. Jessie Maclauchlan—Return.
120. Civil Services (Votes on Account)—Estimate.
67. Bill—Public Houses.
Captain Grant's Cooking Apparatus—Reports.
29. Railway and Canal, &c. Bills (164. Mersey Docks and Harbour Board; 165. Metropolitan Bridges; 166. North Eastern and Stockton and Darlington Railway Companies Amalgamation; 167. Putney and Fulham New Bridge; 168. Rumney and Brecon and Merthyr Tydfil Junction Railway; 169. South Mayo Railway; 170. Tramore Embankment; 171. Tranmere Docks)—Board of Trade Reports.

SESSION 1861.

324 (E.) Poor Rates and Pauperism—Return (E.) (Insane Paupers).

Delivered on 26th March, 1863.

50 (3.) Railway and Canal, &c. Bills—Fourth Report from the General Committee.
55 (7.) Civil Services—Estimates (Class 7.)
116. Army (Expense of Gunner, &c.)—Return.
100. Poor Relief (Lancashire, &c.)—Return.
62. Bill—Writs Prohibition.
Metropolitan Railways—Report by Colonel Yolland.

Delivered on 27th March, 1863.

127. Sir W. Armstrong—Return.
129. Customs Acts (1860)—Return.
95. East India (Plantations)—Return.
109. Fisheries (Ireland)—Return.
Education (Grants to Normal Schools, &c.); Minute of Privy Council.

Delivered on 28th, 30th, and 31st March, and 1st, 2nd, 4th, 7th, 9th, 11th, and 13th April, 1863.

94. Weights and Measures (Metropolis)—Return.
114. Convict Prison (Portsmouth)—Return.
123. Navy (John Clare, &c.)—Return.
126. Army (Military Surgeons)—Return.
130. Galway Subsidy—Return.
131. Treasure Trove—Return.
134. Salmon—Return.
45 (2). Trade and Navigation Accounts (28th February, 1863).
80. East India (Army)—Return.
143. Convicts—Return.
124. Navy (John Clare)—Return.
121. East Asdee Lands (Ireland)—Return.
125. The "Alabama"—Return.
101. Churchyards—Return.
87. Courts of Probate (London and Dublin)—Account.
108. East India (Isthmus of Kraw Railway)—Return.
122. Army (Artillery and Engineers)—Returns.
103. Gethin Colliery Accident—Return.
55 (1). Civil Services—Estimates (Class 1).
55 (3). do. do. (Class 3).
55 (4). do. do. (Class 4).
81. East India (Sedashegar Harbour)—Return.
135. Court of Chancery (Suitors' Funds)—Return.
144. Edinburgh Royal Botanical Gardens—Return.
55. Civil Services—General Abstract of the Grants.
140. Labourers' Cottages (Ireland)—Return.
142. Army (Artillery)—Return.
149. Police Arrangements (London)—Copy of a Report from the Lord Mayor
132. East India (Cotton)—Return.
139. Army (Rifles)—Return.
29. Railway and Canal, &c., Bills.—172. Athenry and Ennis Junction Railway (Abandonment); Athenry and Ennis Junction Railway (Extension of Time); 173. Barnes, Hammersmith, and Kensington Railway; 174. Buckley Railway—Supplemental Report; 175. Dare Valley Railway; 176. Great Eastern Railway (March and Spalding Line); 177. Great Northern Railway (Spalding to March); 178. Hastings Pier, Harbour, and Railway; 179. Ilfracombe Railway; 180. Lancashire and Yorkshire Railway (Doncaster, Goole, and Hull Lines); 181. Metropolitan Railway; 182. Mid Kent Railway; 183. Newry and Greenore Railway, Pier, and Wet Dock; 184. Newtown and Machynlleth Railway (Agreement with Great Western Railway Company); 185. North and South Staffordshire Junction Railway; 186. Oswestry and Newtown Railway (Branches, &c.); 187. Portadown, Dungannon, and Omagh Junction Railway; 188. Potteries Junction Railway; 189. Waterford and Passage Railway and Ferry; 190. West Riding and Grimsby Railway and West Shropshire Mineral Railway; 191. Wolverhampton and Bridgnorth Railway)—Board of Trade Reports.
36. Bills—Jurors' Remuneration.
76. ,, Stocks Certificates to Bearer.
75. ,, Telegraphs (as amended in Committee, on re-commitment, and on second re-commitment).
Fire Insurance Duties—Revised Report.
United States (Suppression of the African Slave Trade)—Additional Article to Treaty.
Bombardment of Belgrade—Correspondence.
Church Estates Commissioners—Twelfth General Report.
Ecclesiastical Commissioners—Fifteenth General Report.
Public General Acts—Cap. 1, 2, 3, 4, 5, 6, and 7.

SESSION, 1862.

307 (B.) Poor Rates and Pauperism—Return (B.)

Delivered on 14th April, 1863.

105. Army (Clothing Factory)—Return.
29. Railway and Canal, &c. Bills (192. Beckenham, Lewes, and Brighton Railway; 193. Boston and Frieston Shore Railway and Pier; 194. Bradford, Wakefield, and Leeds Railway; 195. Great Eastern Railway (Additional Powers); 196. London and North Western Railway (Additional Powers); 197. Ludgate Station and Junction Railways; 198. Midland Railway (New Lines); 199. Oswestry and Newtown and other Railway Companies; 200. Oswestry, Ellesmere, and Whitchurch Railway; 201. Welch and Midland Counties Junction Railways; 202. West Midland Railway; 203. Worcester, Dean Forest, and Monmouth Railway; Wrexham, Mold, and Connah's Quay Railway)—Board of Trade Reports.
Births, Deaths, and Marriages in England—Annual Report of the Registrar-General.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, May 8th*, 1863.]

Dated 14th January, 1863.

166. W. Pidding, Cole-street, Southwark—Imp. in the soles and heels of boots and shoes, in stud nails, tips, and toe or other plates used therewith, and in placing and securing them.

Dated 11th February, 1863.

373. C. P. Carter, Kennington-hall, Kent—Imp. in pavements for roads, streets, or ways.

Dated 26th February, 1863.

540. A. Capello, 4, Rue du Repentir, Marseilles—An improved method of, and apparatus for, glazing Morocco leather.

Dated 9th March, 1863.

655. W. J. Clapp, Nantyglo Iron Works, and N. Coats, Serhowy Iron Works, Monmouthshire—Improved armour plates for vessels, turrets, targets, forts, and other structures in which armour plates are or may be used.

Dated 27th March, 1863.

805. W. Clark, 53, Chancery-lane—Imp. in winding or copping frames. (A com.)

Dated 30th March, 1863.

817. T. Barnes, Earl of Dundonald, 12, Queen's-gate, Hyde-park—Imp. in treating fats and fatty oils and volatile oils or essential oils.

Dated 1st April, 1863.

839. W. Clark, 53, Chancery-lane—Imp. in preventing fermentation in alcoholic and other liquids while drawing them from their containing vessels, and in apparatus for the same. (A com.)

Dated 7th April, 1863.

875. J. Macintyre, Burslem, Staffordshire—Imp. in the manufacture of knobs and other articles in china and earthenware.

Dated 9th April, 1863.

895. F. J. Risse, Carlisle—An improved haft or handle for holding tools or instruments of various sizes.

901. G. Ferrand, Wooley-bridge, Derbyshire—Certain imp. in apparatus for supplying oil or other liquid lubricant to frictional surfaces.

Dated 11th April, 1863.

930. R. Newton, Leeds—Imp. in machinery for separating and straightening the fibres of silk waste and other fibrous substances.

Dated 15th April, 1863.

945. T. Gray, Lower Mitcham, Surrey—Imp. in preparing and bleaching flax, hemp, and other vegetable fibres, by which a brilliant lustre is imparted to those substances, and the fibres are separated.

Dated 20th April, 1863.

984. E. W. Hughes, 28, Great George street, Westminster—Imp. in turn tables, turn bridges, and slips.

Dated 21st April, 1863.

986. H. Rafter, 5, Barr's-hill-terrace, Coventry—An improved process of obtaining printing surfaces.

Dated 22nd April, 1863.

1006. G. B. Barber, Manchester—Imp. in steam boilers, and apparatus connected therewith.

Dated 24th April, 1863.

1014. J. Cavanah, 21, Parron-street, Paddington, Liverpool—An imp. in cricket bats.

1018. J. Sheppard, Canterbury—Imp. in steam engines.

1022. J. Cornes, Roden-villa, and J. C. Davis, Cranbrook-park, Ilford—Imp. in lawn mowing, rolling, and collecting machines.

1024. J. Thompson, Bilston, Staffordshire—Imp. in machinery for punching metals.

1026. J. Hinks and J. Newman, Birmingham—Imp. in the manufacture of buttons.

Dated 25th April, 1863.

1028. C. Pooley, Manchester—Imp. in certain parts of machinery for preparing and spinning cotton and other fibrous substances.

1030. S. Harrison, York-street, Sheffield—A new and improved mode of manufacturing type for letter-press printing.

1032. T. A. Weston and C. Vivian, Birmingham—Imp. in pulleys, capstans, and other machines for raising weights and transmitting motive power.

1036. A. Poirrier and C. Chappat, jun., Paris—Imp. in the manufacture of blue and violet colouring matters suitable for dyeing and printing.

1038. C. Beyer, Manchester—Imp. in safety valves. (A com.)

1042. W. E. Newton, 66, Chancery-lane—Imp. in thrashing machines, part of which imps. are also applicable for hulling, decorticating, cleaning, and polishing grains and seeds. (A com.)

Dated 27th April, 1863.

1048. J. J. Robert, 112, Rue du Temple, Paris—Imp. in the manufacture of spoons and forks.

1050. M. Valkenhuyzen, Paris—A new castor for furniture.

1052. J. Jeffreys, Upper Norwood, Surrey—Imp. in constructing surface condensers, and apparatus for heating and cooling fluids.

1054. R. A. Brooman, 166, Fleet-street—Imp. in twisting and doubling silk, and in frames employed therein. (A com.)

1056. W. Hudson and C. Catlow, Burnley, Lancashire—Imp. in looms for weaving.

1058. H. Beare, Newton Abbot, Devonshire—Imp. in machines for thrashing out corn from its straw, part of which is applicable for combing the straw.

Dated 28th April, 1863.

1060. J. Marris and W. Marris, Great Grimsby—An improved machine for breaking loaf sugar.

1068. G. S. Macdonald, Meard's-street, Soho—Imp. in card cases.

1070. R. Butterworth, Failsworth, Lancashire—Certain imp. in carding engines to be employed for carding cotton and other fibrous substances.

1072. G. E. Donisthorpe, Leeds—Imp. in apparatus used when getting coal and other minerals.

1074. S. S. Marling, Stanley-park, Gloucestershire—Improved machinery for scouring, washing, and cleansing woollen cloths and other fabrics.

Dated 29th April, 1863.

1078. W. E. Gedge, 11, Wellington-street, Strand—An improved system of permanent advertisement. (A com.)

1080. Capt. W. Rodger, R.N., 9, Shawfield-street, King's-road, Chalsea—Imp. in anchors.

1084. G. Holcroft, Manchester—Imp. in the construction of pyrometers.

1086. M. Henry, 84, Fleet-street—Imp. in apparatus for manufacturing beton and artificial stone, pugging clay, and other similar purposes, and in the production of artificial stone, and artistic, ornamental, and decorative articles, works, and surfaces. (A com.)

Dated 30th April, 1863.

1088. A. H. Remond, 4, Moorgate-street—An improved process for retaining the aroma of coffee and cocoa.

1092. C. P. Stewart, Manchester, and J. Kershaw, Duke-street, Westminster—Imp. in engines, machinery, and apparatus for obtaining compressed air, and for applying the power thereof in propelling railway and other carriages.

1094. J. H. Johnson, 47, Lincoln's-inn-fields — Imp. in rotatory engines. (A com.)

INVENTION WITH COMPLETE SPECIFICATION FILED.

1076. E. Rowland, Manchester—Certain imp. in apparatus for weighing solid bodies and measuring fluids, parts of which imp. are also applicable to the opening and closing of dampers.—29th April, 1863.

PATENTS SEALED.

[*From Gazette, May 8th*, 1863.]

May 8th.

3017. G. H. Ogston.
3019. W. Simpson.
3027. J. B. Lavoine.
3037. W. Booth, J. Booth, and T. Booth.
3038. W. Palliser.
3039. H. Burridge.
3040. J. J. Parkes.
3041. E. Marriott and S. Holroyd.
3045. W. Dobson.
3048. F. J. Clowes.
3053. A. Twaddell.
3057. J. Slack.
3058. M. Defries.
3063. R. A. Brooman.
3082. J. Wilson.
313. G. Haseltine.

[*From Gazette, May 12th*, 1863.]

May 12th.

3068. W. H. Andrew.
3077. A. Illingworth and H. Illingworth.
3081. W. H. James.
3083. G. Gray.
3084. F. Palmer.
3089. W. Williamson.
3110. C. Kilner, G. Kilner, W. Kilner, and J. Kilner.
3117. G. W. Oldham.
3124. W. Bottomley.
3136. J. Taylor, jun.
3145. W. Clark.
3147. J. Webster.
3150. W. Clark.
3168. T. Fletcher.
3216. J. Irwin.
3249. H. Swan.
3254. G. Lewal.
3294. J. H. Johnson.
3400. A. V. Newton.
63. G. T. Bousfield.
154. G. Haycraft.
282. W. E. Newton.
307. W. G. Valentin and F. Levick.
446. G. T. Bousfield.
479. W. Wood.
512. R. W. Thomson.
529. W. E. Newton.
532. J. Inglis.
569. D. Collinge.
572. J. Penn.
658. J. H. Johnson.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, May 12th*, 1863.]

May 4th.

1128. J. D. Dougall.

May 8th.

1158. G. Price.
1182. E. Lord.

May 9th.

1170. J. Owen and G. Veitch.
1223. S. Holdsworth, J. Henderson, W. Henderson, and T. Bagley.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[*From Gazette, May 12th*, 1863.]

May 4th.

1057. W. Bulmer and I. Sharp.

May 7th.

1088. A. V. Newton.
1102. R. A. Brooman.
1113. B. Beniowski.

LIST OF DESIGNS OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietor's Name.	Address.
4555	May 6.	Ramrod	James Gunner	War Department, Enfield.
4556	,, 7.	Portable Mangle	Harper Twelvetrees	Bromley, by Bow.
4557	,, 8.	Locket Case and Pendant	George Hazelton	Richard-street, Hockley, Birmingham.